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ORIGINAL

PROVISIONAL SPECIFICATION

CABLE GATE

The invention is described in the following statement:

CABLE GATE

FIELD OF THE INVENTION

The present invention relates to an improved gate, and in particular to cable or chain security gates, and may for example be used to replace existing boom and security gates.

BACKGROUND OF THE INVENTION

Conventional gates are used either to prevent unauthorised access to a site (security), or for access control purposes.

Security gates prevent vehicular access and are constructed in a variety of formats. Typical examples incorporate sliding, swinging, or vertically raising (or lowering) panels, and are constructed of steel tube, wood, steel mesh, plastic, other materials, or combinations of these materials. The gates may be manually opened, or may utilise one of a number of alternative hydraulic, electrical, electro-hydraulic, or other actuation mechanisms. Automatic control devices may also be provided, to allow for remote (wireless) or security system opening of the gate. As well as preventing unauthorised access, these gates also provide access control.

Another form of access control gate is the boom gate, constructed typically of a long wooden or steel beam pivoted about a horizontal axis at one end. Applications include access control into public car parks, and as warning devices at railway level crossings. Boom gates are used more for access control, than security purposes, as it is not very practical to construct them strong enough to prevent deliberate unauthorised access. These gates may also be automatically, manually, or remotely opened and closed.

A number of functional weaknesses may be noted for most conventional gates, particularly automatic gates.

Most automatic gates are quite expensive to purchase and operate, as the gate panels are heavily and expensively constructed, their actuation mechanisms are large and costly, mechanical and electrical or hydraulic services must be installed and connected between the gate and a suitable source, and considerable work is needed to provide the foundations for the necessarily precise gate mechanisms.

Existing gates are also not very space efficient. For example, a swinging gate must have room for the gate panels to swing into, and the panel of a sliding gate requires at least the full opening width again, behind an associated fence. Similarly, poles that are raised telescopically from a hole in the ground require substantial below-ground excavation, and are prone to jamming due to the ingress of sand and water.

Further, many gates are not constructed strong enough to withstand deliberate attempts at unauthorised access, and most automated gates are relatively slow to open (for safety reasons).

Conventional swinging, sliding, or raising gates also tend to be quite slow to open and close, particularly if they are built heavy and strong to withstand deliberate attempts at unauthorised access. The reasons are twofold. Firstly, the inertia of these types of gates is large, requiring high accelerating forces to achieve reasonable speed of operation. This would require large and expensive actuation mechanisms, making the whole approach commercially unattractive. The second, and more important reason, is that heavy gates travelling at high speed (and using high forces) would present a serious hazard to personnel, animals, and equipment such as vehicles. This is because, due to the extremely high inertia levels that would be involved, their overload protection and other safety devices would be rendered ineffective. This is particularly the case if the gates are automatic, and therefore may be operated unintentional, or unexpectedly.

Slow opening times can be particularly annoying to the user, who may need to make regular authorised accesses to a secure site. For example, this may include a home owner entering his own property, or someone wishing to legitimately enter a private parking area. Generally, it is usually not so important for the gate to close quickly.

OBJECT OF THE INVENTION

It is an object of the present invention to provide a gate which addresses at least one of the weaknesses of conventional gates identified above. In particular it is an object of the present invention to provide an improved gate that is low in power consumption, space efficient, fast to open, in-expensive to

manufacture and install, intrinsically safe, and ideally automatic and more effective in restricting deliberate attempts at unauthorised vehicular access.

SUMMARY OF THE INVENTION

With the above object in mind the present invention provides in one aspect:

a gate for controlling passage through an opening including:

a first support means located on one side of the opening;

a second support means located on the other side of the opening;

at least one elongate member extendable across the opening between said first and second support members; and

a control means for releasing said at least one elongate member to thereby enable passage through said opening, and drawing in said elongate member to thereby restrict passage through said opening.

In the preferred embodiment the elongate member could be a cable, or alternatively a chain, rope, cord, rod or pipe provided with flexible end fittings, or similar arrangement.

In a further preferred embodiment, the first and second support means could be posts. Alternatively, walls, or many other forms of architectural structures (for example columns, arch supports, beams, light poles, or even statues), could form the support means.

Preferably, the control means would be located substantially wholly within one of said first or second support means, to limit access to said control means.

The gate could further include a locking means to prevent unwanted release of the at least one elongate member once the at least one elongate member has been fully drawn in. Conveniently the locking means could include a latching means adapted to engage a thimble assembly attached to the at least one elongate member.

Preferably the gate further includes a first line connecting said at least one elongate member to said control means such that said control means operates to draw in said first line thereby drawing in said at least one elongate member. Ideally, the first line is thin and lightweight, for example it could be a

steel or synthetic cable or strap. Further, the first line could be attached to said thimble assembly.

The first and/or second support means may further include a first tracking means to draw said at least one elongate member towards said first support means during release of the at least one elongate member. The first tracking means may include an aperture in said first support means through which a counterweight line may pass. One end of said counterweight line being attached to said at least one elongate member, and the other end attached to a counterweight.

Ideally the aperture would be located a predetermined distance below said at least one elongate member and substantially equal to the distance between said first support means and a point where said counterweight line is attached to said at least one elongate member.

A further improvement to enable tracking of the said at least one elongate member along a side of said first support means would include a bar running along an end portion of said at least one elongate member, and adjacent to said first support member.

Where a plurality of elongate members are provided, it may be preferable to provide a bar, running along an end portion of each, or a selection of, the elongate members, to further improve tracking.

Alternatively, said at least one elongate member is connected to a bar pivotally attached to said member.

Alternatively, a resilient means could be utilised in place of said first tracking means.

The control means will preferably include a winch means including:

a winch drum fixed to a drive shaft.

Preferably, however, the control means could include a winch means including:

a winch drum adapted to freely rotate on a drive shaft;

a drive collar rotatable with, and slidable along, said drive shaft;

an engaging means adapted to enable said drive collar to engage and disengage said winch drum.

Ideally, a braking means is provided to limit the speed of the winch drum when not engaged with said drive collar.

In a further preferred aspect the present invention provides a second tracking means to track said first line along said winch drum including:

a fixed pulley;

a second pulley mounted on a arm, said arm being spring loaded and capable of swinging;

wherein said first line tracks around said fixed pulley and then said second pulley prior to being wound on said winch drum.

In another preferred aspect the present invention provides an improved latch mechanism including:

a latch or locking pin adapted to be released by a release lever;

a first and a second spring each fixed at one end;

a belt passing around a pulley means and connecting said first spring to said second spring; and

a release line attached to said release lever and said belt.

Conveniently, the release line may pass through the centre of the first spring, or alternatively in some arrangements the release line may pass outside of the spring.

In the preferred embodiment of the present invention the latch mechanism would be driven by said winch means. Further, the release lever would also include a return spring adapted to return the release lever to a locked position.

In a further aspect the present invention provides a latch mechanism including:

a latch or locking pin adapted to be released by a release lever;

a member attached via a ratchet means to a winch means; and

a release line joining said release lever to said member.

In a preferred aspect the present invention provides an improved latch mechanism including:

an assembly adapted to slide along and rotate with a drive shaft; said assembly including a pulley and clutch dog;

a plurality of cams, including a first and second cam;

a plurality of reaction plates, including a first and second reaction plate; wherein said first cam is adapted to engage said first reaction plate, to thereby engage said clutch dog with a winch means; and said second cam is adapted to engage said second reation plate, to thereby disengage said clutch dog from said winch means.

In some applications it may be desired to provide a series of gates as defined by the present invention. In such an arrangement a predefined distance may be left between adjacent gates, or alternatively two adjacent gates may have a common support means.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be further described with reference to the accompanying drawings. It will be appreciated by the person skilled in the art that other embodiments of the present invention are possible, and therefore the particularity of the accompanying drawings is not to be understood as superseding the generality of the preceding description of the invention.

Figure 1a shows the basic format of the improved gate in both a closed and open configuration.

Figure 1b shows the master post of the preferred embodiment.

Figure 2a shows the cable configuration in relation to the master post.

Figure 2b shows the locking mechanism of Figure 1b.

Figure 3a shows the drive mechanism of the preferred embodiment.

Figure 3b shows the winching mechanism of the preferred embodiment.

Figure 4a and 4b shows the latch mechanism of the preferred embodiment.

Figure 5 shows the passive post arrangement of the preferred embodiment.

Figures 6a to 6e show the quick release arrangement of the preferred embodiment.

Figure 7 shows the winch braking arrangement of the preferred embodiment.

Figure 8 shows the cable tracking arrangement of the preferred

embodiment.

Figure 9 shows the lock detecting arrangement of the preferred embodiment.

Figures 10a and 10b show the principal of the V-belt arrangement.

Figures 11 and 12 show an improved clutch mechanism for use with the present invention.

Figure 13 shows an alternative release cable arrangement.

DETAILED DESCRIPTION OF DRAWINGS

Referring now to Figure 1, the present applicants have found it feasible to construct a security gate using steel cable or chain stretched between two anchor posts. By making the cable or chain permanently anchored at a first post, and capable of being fed out from, or drawn into a second post, it is possible to effectively open and close the gate to vehicular traffic. Alternatively, the cable or chain could also be fed out from, and drawn into the first post as well as the second post, if required. In the open position, the cable or chain would be arranged to lie on the road or ground surface, or in a suitable groove, for vehicles to drive over. When closed, the cable or chain would form a barrier between the two posts, preventing access.

If high strength steel cable or chain had been previously considered for the gate of the present invention then conventional teaching of a means for reeling the cable or chain into the post would have resulted in a necessarily large, heavy, expensive, and bulky apparatus. This is because the winch drum must be of sufficiently large diameter to accept the heavy cable or chain, and must be sufficiently strong to support the maximum tension loads if an attempt is made to breach the gate. For steel cable, the winch drum must also be sufficiently large to prevent the cable from going below a minimum bend radius, thereby compromising the cable's fatigue life, or from being irreversibly distorted which will render it unusable in that it would not lie flat on the road.

Therefore, in the present invention, a high strength cable, preferably steel, may be anchored to a passive post located to one side of an opening or roadway, and the other end of the main cable can be drawn into a master post located on the other side of the roadway, by means of a thin light-weight "pull-in"

cable, as shown in Figure 2a. This second end of the main cable is fitted with a thimble assembly (or similar), which can be locked into place in the master post by a latching mechanism once the gate is fully closed (refer to Fig 2b).

In the preferred embodiment a 10 mm diameter stainless steel wire rope forms the main cable, as this provides a suitably high level of strength, is corrosion resistant, is relatively difficult to cut, and does not cause undue damage to the road, or impede the passage of normal vehicles over it. Depending on the application and strength requirements of the cable, larger or smaller diameter cable can be selected, or even synthetic cord or rope can be utilised.

It has been found that an 8 tonne force would be required to pull out a 10 mm steel cable from the master post of the present invention. Accordingly, the selection of the post material and/or modifications of the post may be necessary dependent on the cable selected for the particular application, so as to ensure the gate works effectively, and that the post is not unduly weak.

The pull-in cable strength, and therefore diameter, should be selected to suit the main cable span, and diameter or weight of the main cable. Tests have shown a 1.6 mm diameter cable to be suitable for use with a 10 mm diameter main cable over realistic spans, providing both satisfactory performance and fatigue life. Ideally, the pull-in cable is also a stainless steel wire rope for its corrosion resistance, and should be of a flexible weave to enable the cable to lay neatly on the winch drum and pass easily over the pulleys.

Once it is in place and locked, then the main cable is unable to be withdrawn from the master post even at high force levels, unless the latch is first unlocked. This is ideally performed by an internal mechanism, that is, a mechanism that is not readily accessible from the outside of the gate. The latching function may take the form of a pivoting pin (as shown in Fig 2b). This form of latch is in a sense self-energising, in that any attempt to withdraw the main cable only acts to more strongly hold the latch closed. It is necessary for the pin to be rotated against the cable load, in order for the cable thimble to be released. A lever arm attached to the locking pin pivot shaft may be utilised to perform this unlocking function. Alternatively, a retracting bolt or other form of

latch could be utilised.

The internal mechanism required to release the latch might take the form of an electrical solenoid, which could for example pull back a bolt, an electric motor drive, a manually operated key assembly, or other similar means.

The present invention could be operated by a simple control system used to control operation of the electric motor, and of the unlocking mechanism. Additionally, micro-switches may be used to detect both the locked and unlocked status of the gate.

The pull-in cable is not exposed to the security loads needed to be withstood by the main cable, and therefore need only be strong enough to draw, or pull-in, the main cable to the master post latch mechanism, and may therefore be constructed using quite small diameter wire rope, or even synthetic material such as a nylon rope. The pull-in cable winch drum may similarly be constructed to be physically small, of low cost, and light-weight. In the preferred embodiment, the winch drum and winch shaft are made of inexpensive plastic materials, and are small enough to be fitted within the master post. Similarly, the winch drive mechanism may also be constructed using small, light-weight, and inexpensive componentry. In the preferred embodiment, this drive mechanism makes use of a very low-cost electric motor and drive assembly, such as normally might be used for high volume automotive application, for example driving windscreen wipers or window winders, that is mounted outside of the master post. Figure 3 shows this arrangement. Alternatively in some embodiments if may be feasible and preferred to mount a smaller drive motor inside the existing post, or to fit the prototype motor within a slightly larger post.

Manual methods may also be used to activate the winch mechanism. For example, a crank handle and ratchet mechanism could be used in place of the electric motor, or a single stroke foot driven treadle device, or even a pull rope wrapped on a spring returned drum could be utilised. Or, a simple rope could act directly as a pull-in cable, for a manually closed system.

The use of the pull-in cable in conjunction with the main cable provides a gate that is of low cost, is strong, and is considerably more space efficient than conventional gate formats. The small drive mechanism also has very low

power consumption characteristics, making it attractive for applications that are power sensitive, and may therefore be battery or solar driven and not just mains driven.

In a preferred embodiment, the winch drive that draws in the pull-in cable may also be used to activate a latch release lever attached to the locking pin pivot shaft (when driven in the release direction). In this improved release mechanism, the release cable is activated from the pull-in cable winch drum shaft, using the principles of a capstan drive. Figure 4 shows the format of one embodiment, which makes use of a V-belt system to keep the drive physically small. As can be seen from the reference to Figure 4a, when the winch is rotating to draw in the pull-in cable to close the gate, then due to friction on the belt, spring A will continue to stretch until the force in spring B approaches zero. By this means the release cable is de-tensioned, allowing the pivoting latch to be returned to its locked position by means of a return spring. Thereafter, the winch may continue to reel in the pull-in cable, without spring A being further stretched. This is because the V-belt is now able to slip on its pulley.

Similarly, when the gate is required to be opened the electric motor and winch shaft (carrying the V-belt pulley), are arranged to rotate in the reverse direction. This causes spring B to be stretched, carrying with it the release cable, which then acts on the pivoting latch release lever (Fig 4b). This action continues until the latch is able to unlock the main cable end, and until the force in spring A approaches zero. Note that until spring A is de-tensioned, the force that the V-belt may apply to the release cable is extremely high. This is because the tension in the belt will increase exponentially around the pulley (as per the action of a capstan drive). The length of spring A and the release cable is adjusted to ensure that the latch will fully disengage. Thereafter, the winch is able to continue to reel out the pull-in cable (allowing the main cable to drop, thereby opening the gate), without further stretching of spring B.

The release cable must be strong enough to retract the latch release lever, and ideally flexible enough to pass over a pulley. A 1.6 mm diameter stainless steel wire rope has been found suitable for this function. Conveniently, the release cable attached to the release lever, passes around a pulley, and

through the centre of spring B, and is attached to one end of the belt. Alternatively, in some arrangements it may be preferable to lengthen spring B such that it is not practical to have a spring B and the release cable anchored at the same, or a similar, position. In these circumstances, the spring B may be angled such that it is anchored at a different location, while still peforming the same function. In these circumstances, it is more convenient for the release cable to pass outside of the spring as demonstrated in Figure 13.

The present invention therefore also provides a means of releasing the latch mechanism using a few small, simple, and inexpensive components, while at the same time providing a very high release force capability and may derive its power from the existing winch drive electric motor (or other) drive mechanism.

As an alternative to the latch mechanism disclosed above, the pulley, belt and spring arrangement could be replaced with a spool or arm attached to the main drive shaft by means of a ratchet arrangement. The release cable or line would attach to this spool or arm. When operating in the pull-in direction, the ratchet would allow the spool or arm to remain stationary as the shaft turns to draw in the first line. However, when the motion of the shaft is reversed, the ratchet would act to force the spool or arm to rotate with the shaft, thereby winding in and pulling the release line.

During development it was found that a point is reached during the opening cycle, once sufficient chain or cable has reached ground level, when friction between the cable and the ground (or road surface) will hold the remaining chain or cable away from the passive post and thereby results in the opening width for traffic flow between the gateposts being effectively reduced.

Referring now to Figure 5, in the preferred embodiment, as the main cable is lowered by the master post, a counter-weight inside the passive post is able to pull in the cable against that post. This may be achieved via a small access hole in the passive post, a counter-weight cable, and one or more small pulleys. Similarly, as the main cable is raised to close the gate, tension in that cable acts through the counter-weight cable to raise the counter-weight to its normal (closed gate) position. A spreader bar attached to the cable can further improve the ability of the main cable to track along the side of the passive post,

ensuring that the cable is drawn well into position adjacent to the post, for the full height of that post, thereby providing a greater effective opening between the posts.

In an alternative arrangement springs may be used in place of the counter-weight.

A further alternative is to include a bar as part of the cable. That is, the cable can be connected to a bar which is pivotally attached to the post. The cable and the bar then combine to extend across the opening. When the cable is released, the weight of the bar would assist in causing the bar to pivot down along the side of the post, thereby drawing the cable. Alternatively, rather then being pivotally attached to the post, the bar could be joined to the post by a length of cable attached to the post and the bar.

As previously noted conventional gates are slow to open. In a preferred embodiment the present invention provides a gate having safe, short opening times. This can be achieved as no hazard is presented by rapid opening of the gate, and gravity may be utilised to effect the short opening time.

In the arrangement shown in Figure 6, the winch drum is made free to rotate on the driven shaft (Figure 6b). A separate drive collar is attached to the shaft in such a manner that it is forced to rotate with the drive shaft, but is free to slide along part of its length. In the preferred embodiment, the collar is located on the shaft by means of a pin passing through a slot in that shaft. Alternatively, however, a spline joint or similar arrangement could be provided. This drive collar is provided with extending dogs (Figure 6b) that may be engaged into recesses in one of the winch drum end flanges, and a spring is used to hold the winch drum and drive collar apart. This provides a form of dog clutch between the motor driven shaft, and the winch drum.

The opposite side of the drive collar is provided with extending cam followers, which engage with a face cam and hub also mounted on the drive shaft (Figure 6c). The cam hub is also free to rotate on the drive shaft, but only over a limited range of travel. This may conveniently be done by providing a drive shaft arranged to engage in a segmented slot in the cam hub. By applying a suitable retarding force (eg. via a friction brake block, or similar), the face cam

will be prevented from rotating as the drive shaft rotates, causing it to remain stationary until its travel limit is reached relative to the drive shaft (Figure 6d). Thereafter, the face cam and drive shaft will rotate together. As will be seen, this cam arrangement is used to automatically engage and disengage the winch clutch. Conveniently the face cam, and the V-belt pulley previously described, could be manufactured as one unit. By this means the V-belt pulley is able to provide the necessary cam retarding force, thereby doing away with the need for a separate retarding system. It will be appreciated that other arrangements to engage the clutch are also possible, and the various cam and clutch elements could equally be swapped between components. For example, the clutch dogs could form part of the winch drum, and the clutch recesses could be manufactured in the drive collar.

In the preferred embodiment, and starting with the gate fully open, this quick release improvement operates as follows.

Referring to Figure 6d, the motor drive will commence rotating the drive shaft clockwise, and the V-belt pulley and face cam assembly will rotate with the shaft and drive collar until the forces in springs A and B become approximately equal. As further rotation occurs, the face cam will tend to be held stationary by the V-belt pulley. However, the drive shaft and drive collar will continue to rotate. Therefore, the drive collar cam followers will be caused to ramp up the cam faces (Fig 6c), forcing the drive collar to slide along the drive shaft towards the winch drum. By this means, the clutch dogs are caused to engage with the winch drum. This forces the winch drum to be rotated, drawing in the pull-in cable. The travel limits on the face cam prevent the cam followers from travelling beyond the point of maximum lift.

From this point the drive shaft, face cam, V-belt pulley, drive collar, and winch drum all continue to rotate as one. This process continues until the main cable is locked into the master post by the latch assembly, at which time the gate control system stops the drive motor. To cause a very rapid opening of the gate, the control system starts the drive motor in the opposite (in this case anti-clockwise) direction, when the following sequence of actions occur.

Firstly, the spring forces equalise as all components rotate as one, and

the pull-in cable tension is released. However, the main cable is not released at this time. Next, the V-belt pulley and face cam assembly is again held stationary as the drive shaft and collar continued to rotate. This allows the cam followers to drop down the cam faces, thereby allowing the clutch spring to disengage the clutch dogs from the winch drum. Finally, however, the face cam travel limits are again reached, and the face cam and V-belt pulley assembly is caused to commence to rotate. This action causes the V-belt to pull the latch release cable (Fig 6e), thereby unlatching the main cable. The control system can stop the motor drive at this point. Because the winch drum is now free to rotate, the main cable rapidly falls away under the action of gravity, towing the pull-in cable with it. This completes the entire closing opening cycle.

In summary, in a "neutral" or unloaded condition, both the upper and lower balance springs are under tension. These apply load to each end of the V-belt, which is wrapped around the main drive pulley. Referring to Figure 10A which exemplifies the "unlocking action". Here, a significant spring tension is being applied to the V-belt at point "C", and the pulley is being rotated anti-clockwise (by the main drive shaft). Under this condition, the V-belt is able to develop an extremely large tension force at point "A", due to an exponential increase of force as the belt wraps around the pulley. A "latch release cable", shown at "B", may generate a very high force, if necessary, to release the gate latch.

Similarly, when the pulley is rotated clockwise, a point is reached when the lower balance spring collapses to its solid height ("Y"), and the upper spring has stretched to point "Z". The lower spring will then be exerting very little tension on the V-belt, approaching zero. The V-belt will then commence to slip on the pulley, while the upper spring remains stretched to point "Z". The drag torque on the pulley will be approximately the force at "Z", times the pulley radius.

During opening of the gate, as the winch drum is free to rotate, It has been found that a brake block applied to the winch drum, is useful to prevent uncontrolled reeling of the pull-in cable. Spring tension may be used to apply the brake force. In addition, a separate finger assembly may be used to clamp

the pull-in cable against the winch drum, to keep the cable tightly coiled on that drum. This helps the cable to reel evenly, thereby prolonging it's operating life. Conveniently, a single spring may be used for applying force both to the brake block, and to the coiling control finger unit. Figure 7 shows one format on this arrangement.

The above latch configuration uses a fraction of the drag torque to actuate the clutch. As the torque is increased, the pulley is retarded, carrying with it the cam faces. In turn, the drive collar is forced along the shaft (as it is unable to rotate on the shaft) by the associated cam followers. This engages the clutch, which then commences rotation of the winch drum, reeling in the "pull-in" cable. A spring is utilised to disengage the clutch following this stage.

In some environments, the above configuration may not be optimum. For example, if the pulley were to become excessively tight on the shaft for any reason, or the collar prevented from easily sliding along the shaft (e.g. due to sand contamination), then a point may be reached when the V-belt commences slipping (at "Z"), before the clutch has engaged. In this circumstance, the drive would continue to rotate, but the winch drum would not be rotated to reel in the "pull-in" cable. Accordingly, the gate would fail to lock. Alternatively, the clutch may fail to disengage if the collar becomes jammed with sand.

Whilst, in some circumstances, a shroud around the operational components may be sufficient protection from environmental contamination or the like, in extreme conditions an alternative arrangement, as shown in Figures 11 and 12, may be adopted. In this arrangement, the main pulley and clutch dogs are integrated into one unit, which is free to slide along the main drive shaft, but forced to rotate with it. This is accomplished by machining a slot in the shaft, through which a pin, pressed into the pulley, passes. Although other arrangements would be known to the person skilled in the art, for example, a sliding keyway.

At least two cams and two reaction plates are provided for this arrangement. One cam and reaction plate act to engage the clutch, and the other set to disengage the clutch. The cams are rigidly attached to the V-belt. In Figures 11 and 12, the "disengage" cam is not visible as it is located below the

pulley. However, the principle of the "disengage" cam is the same as the "engage" cam.

Referring to Figure 11, which shows the action of unlocking the gate (assuming the pulley is rotating anti-clockwise), the clutch dogs are disengaged from the winch drum. The winch drum is therefore free to unreel the cable for the "quick release" function.

Referring now to Figure 12, the pulley is now being rotated clockwise to close the gate. The "engage" cam has been driven against the bevelled edge of the "engage" reaction plate, forcing the pulley and associated clutch dog(s) along the shaft, causing the clutch dog(s) to engage with the winch drum. The "pull-in" cable is thus reeled in, closing the gate.

In the previous embodiment, the V-belt pulley was free to rotate about (over a limited range of travel), but not to slide along the main drive shaft. This pulley carried with it one or several face cam surfaces. A separate drive collar carried cam followers on one face, and clutch dogs on the other. This collar was made free to slide along, but not rotate about the drive shaft, and arranged so that the cam followers would engage with the pulley-supported cams. By this means, the action of the belt on the pulley would force the clutch dogs into engagement with a winch drum when rotated in one direction, but allow a spring to disengage the clutch when operated in the other direction.

The improved arrangement makes the clutch action far more positive. In this arrangement, the pulley, which may conveniently be made of aluminium, carries with it the clutch dogs. The pulley is made free to slide along, but is forced to rotate with the drive shaft. At least two cams are directly attached to the belt, at least one to engage the clutch, and at least one to disengage the clutch. These cam act against "reaction plates". Figures 11 and 12 show the arrangement of the "engage" cam and its associated reaction plate (the other cam is hidden).

Figure 11 clearly shows the clutch dog is out of engagement with the winch drum. If the pulley is now rotated to the right, it is clear it will carry with it the belt, and the associated cams. The "engage" cam will act against its reaction plate, thereby forcing the pulley and clutch dogs along the shaft, to

engage with the winch drum. Figure 12 shows this clearly.

Note that the "disengage" and "engage" cams must have clearance between their operating zones, to avoid jamming. That is, the disengage cam must be in the process of moving out of the way before the engage cam starts moving the pulley along the shaft. The reverse also applies.

Another improvement has been to have the flanks of the cams extend down each face of the pulley. This causes the cam actuating loads in the axial direction, to be carried directly from the cams to the pulley, rather than via the belt. As these forces may be quite high in some circumstances, this improvement acts to improve belt strength and life, and to prevent the belt from being lifted or twisted from the pulley.

For convenience, the V-belt may be replaced with a poly V-belt, which simplifies the means of attachment of the cams to the belt, as well as allowing a significant improvement to the way the springs may be attached.

Whilst this arrangement is more expensive to manufacture than the alternative arrangement, this improved clutch design does provide a more positive clutch action. Recalling the capstan principle, it becomes clear that the belt is able to exert a very large force onto the cams, ensuring the clutch will both engage, and disengage as required.

Referring to Figures 10B and 12, as the pulley rotates clockwise we see the engage cam will be strongly forced around the pulley (by the belt), until the lower balance spring closes to its solid height (and "unloads" the belt). But the belt will not be able to unload until the cam has reached its final position, alongside its corresponding reaction plate. At this point, the clutch must be engaged.

The reverse applies. The disengage cam must disengage the clutch before the upper balance spring can become unloaded.

Such a quick release system could result in the gate opening in less than one second. It would not be practical to provide this level of performance in a conventional gate system. Further, this arrangement saves a considerable power consumption, allowing the gate to be utilised in applications which are power sensitive. In the preferred embodiment, the inclusion of the quick release

mechanism also improves the operation of the counterweight mechanism. As the main cable rapidly drops following release, it initially allows the counterweight to almost "free fall" building up a high speed. Because of this speed, when the main cable reaches the ground, the inertia of the falling counterweight, in combination with its weight, is very effective in drawing the main cable up tight to the passive post, thereby ensuring the maximum opening of the gate.

In order to operate smoothly, it is highly preferable for the main and pull-in cable to run centrally into the master post, but for the winch drum to be located with considerable offset from the centre line. This arrangement provides better internal space for the various other gate mechanisms. Further, the pull-in cable should be fed onto the winch drum in such a manner that it reels on neatly and evenly.

Additionally, it is useful for the gate control system to be able to sense an overload condition, thereby allowing appropriate control action to be taken in this event.

Referring now to Figure 8, in order to achieve this a simple fixed pulley is used to re-direct the pull-in cable (from the centre-line) around a second pulley mounted on a spring-loaded swinging arm. By this means, at low loads the pull-in cable alignment may be offset to one side of the winch drum, but as the cable load increases then the swinging arm will pivot to cause the pull-in cable to track across the winch drum surface. A limit stop is ideally provided to establish the minimum load position, and the selected spring characteristic determines the rate at which the cable is offset verses load. A limit switch may be provided to detect abnormally high cable loads, and used as an input to an associated control system able to cut power to the drive, or take other appropriate control action.

It is a characteristic of the cable gate of the preferred embodiment, that the pull-in load required to close the gate will initially be small, but will increase to a maximum level once the gate is fully closed. Similarly, the cable should be tracked across the winch drum at the rate of one cable width per drum rotation.

Through the selection of an appropriate spring design, the present

invention is able to approximately match these two characteristics. That is, as cable is reeled in and the main cable is raised, then the increasing cable tension forces will cause the cable to be tracked across the winch drum at an approximately correct rate. Therefore, the cable will be reeled in neatly and evenly, and abnormally high loads will be detected by the limit switch.

In certain applications, the functionality of a cable gate may be enhanced using multiple cables, signs, and panels etc. These additional features would be attached to (or may form part of) the main cable, and could be raised by it. the only requirements should be that the attached components must allow the main cable to slide through them, they must collapse fully to ground level, and they must be compatible with the passage of vehicular traffic over them.

For example, horizontal and vertical cables may be attached, or a sign may be hung from the centre of the gate span (so that vehicle wheels could track either side of the sign). A second (or more) cable(s) may be anchored near the base of both the master and passive posts, and raised by vertical tie cables attached to the main cable by sliding joints. When opened, the main cable would slide through these vertical ties, allowing the entire assembly to drop to the road surface.

Alternatively, the main cable may be anchored at a low point on the master post, but pass through pulleys spaced apart in the passive post, to return to the normal latch position on the master post. When opened, the entire cable would thereby be allowed to drop to ground level.

Ideally, it is necessary to detect both that the latching pin is in the locked position, and that the cable end (eg. thimble) is correctly in position, to be assured that the gate is fully and correctly locked. It is insufficient to only detect the position of a thimble, as this could occur without the latching pin being in place. Similarly, in the preferred embodiment the latching pin is raised prior to entry of the cable end, and therefore does not indicate a "locked-gate" condition.

It would be possible to utilise separate micro-switches to detect both that the cable end is in place, and that the latching pin is raised. However, this would require additional switch mounting and wiring etc., which is not preferred due to the additional space, wiring, and costs involved. An alternative is to

mount a single limit switch onto the pivoting latch pin assembly, arranged to detect the presence of the cable end only when the latch is in the raised position. This method is also not preferred, as the limit switch is exposed to high vibration loads, and its wiring is subject to fatigue failure due to multiple bending.

As shown in Figure 9, in an alternative arrangement a cam surface carried on the latch pin assembly is generated to form a radius about the pivot point of that pin assembly in the absence of the cable thimble. A spring-loaded cam follower, mounted on a swing arm attached to the frame of the gate mechanism, is arranged to just clear this cam surface. However, if the cable thimble is in place when the latch pin is raised, the cam is caused to rotate to a position outside of the original radius. This in turn causes the cam follower to be activated, which motion may be easily sensed using a fixed micro-switch.

This therefore allows for the use of a single, fixed, micro-switch to reliably detect both that the latch is in the locked position, and that the cable thimble is in place.

Modifications and variations to the cable gate of the present invention may be apparent to one skilled in the art upon reading of this disclosure and such modifications and variations form part of the scope of the present invention.

DATED this 2nd day of July 1999

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263 ADELAIDE TERRACE
PERTH WA 6000

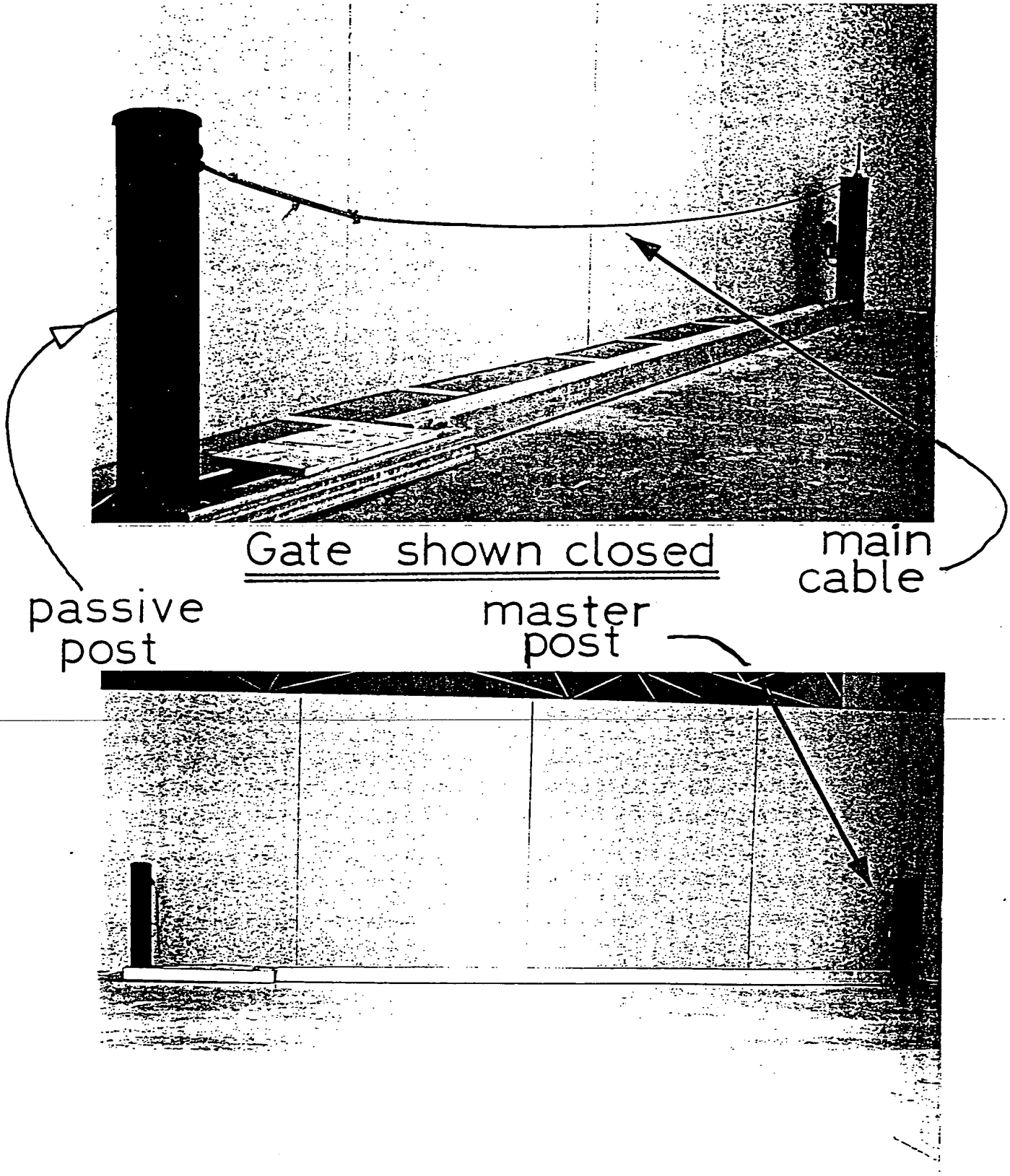
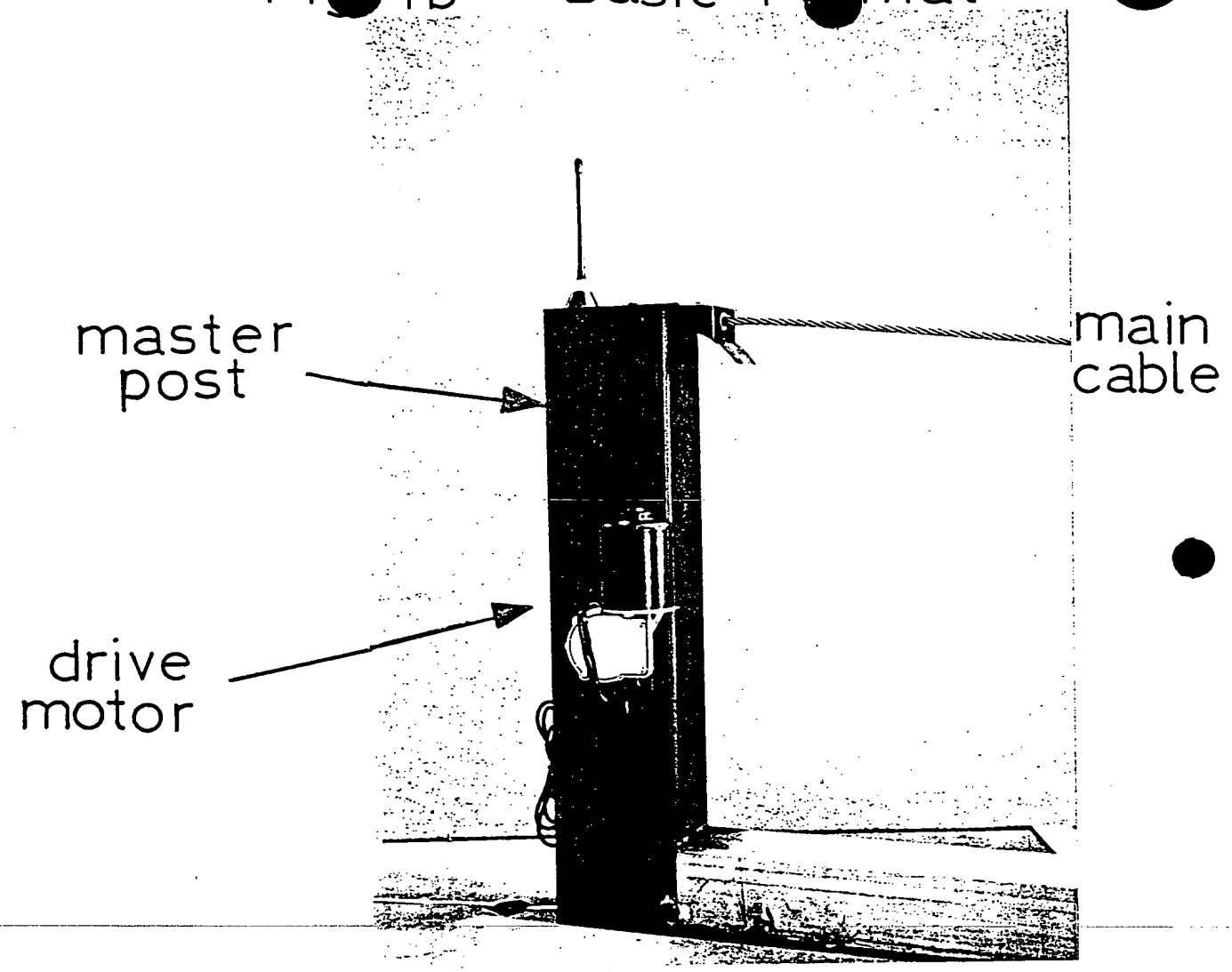
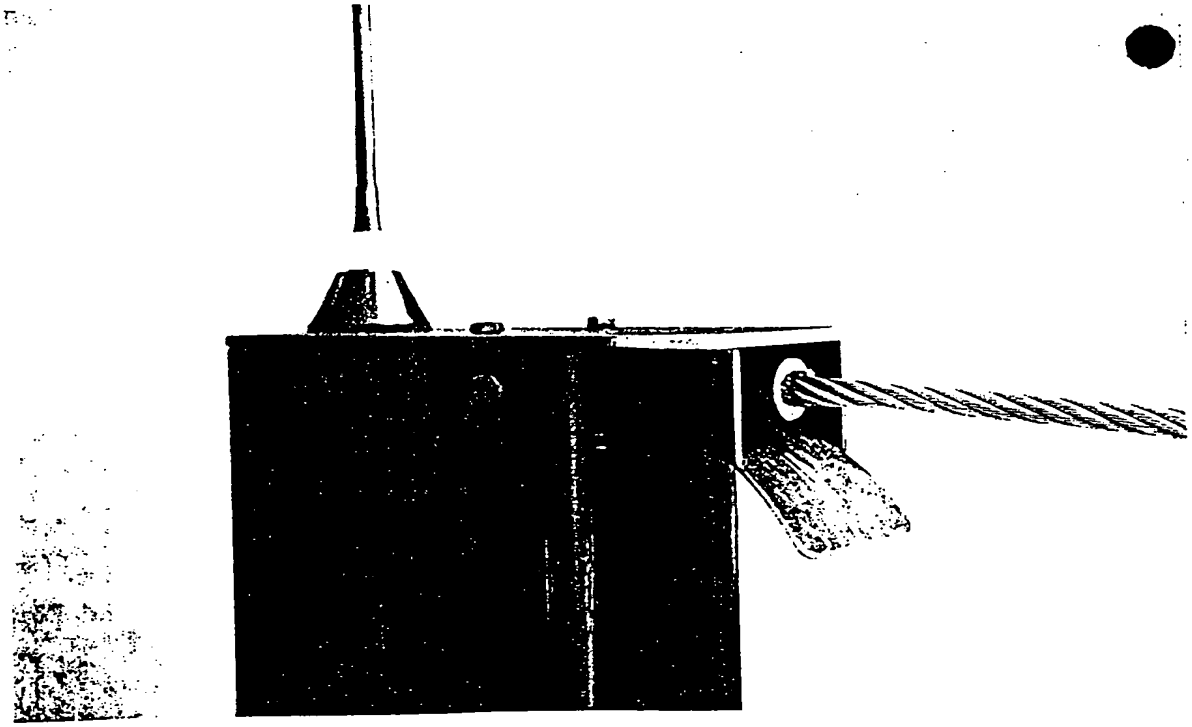


Fig. 1a – Basic Format

Fig 1b – Basic Format





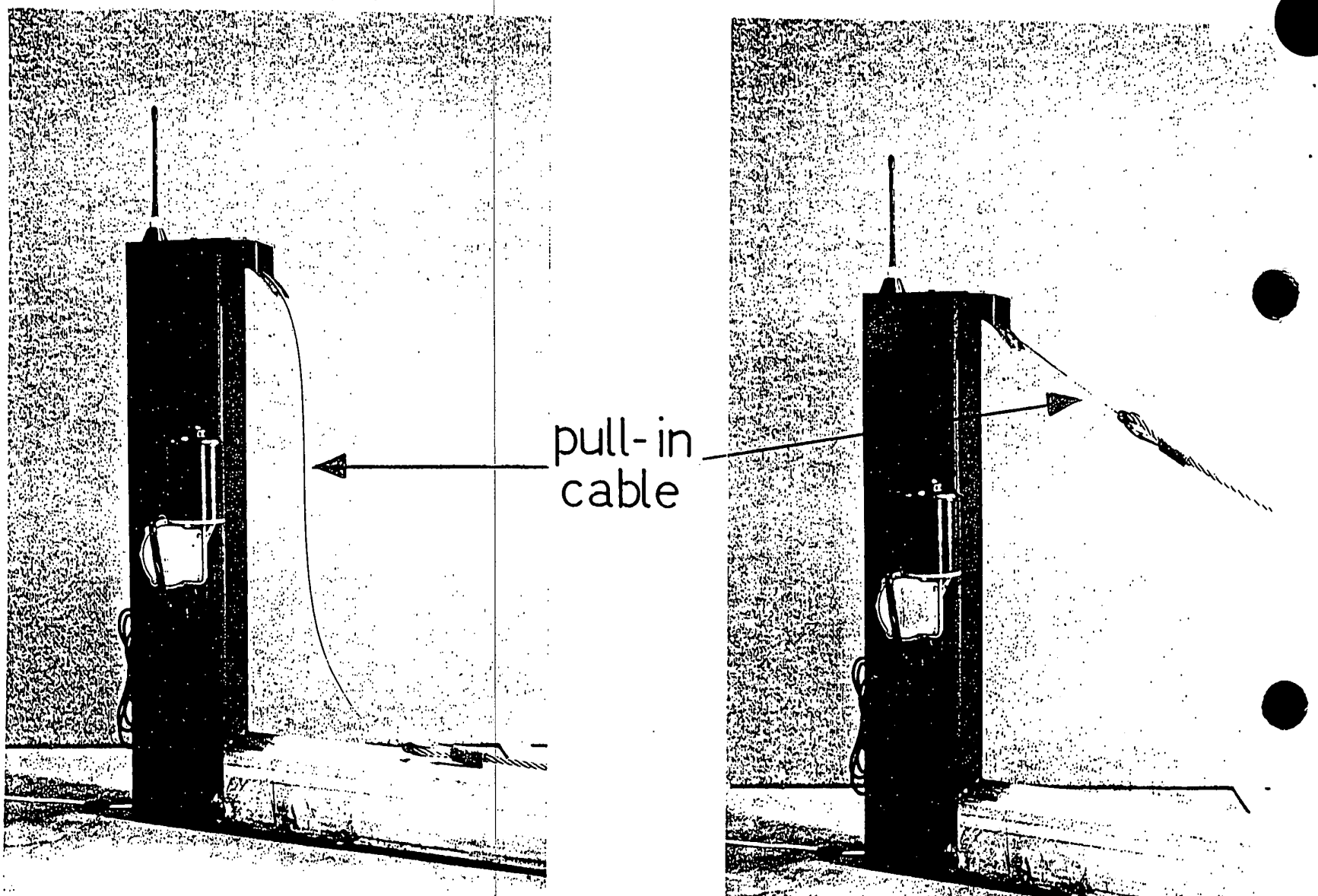
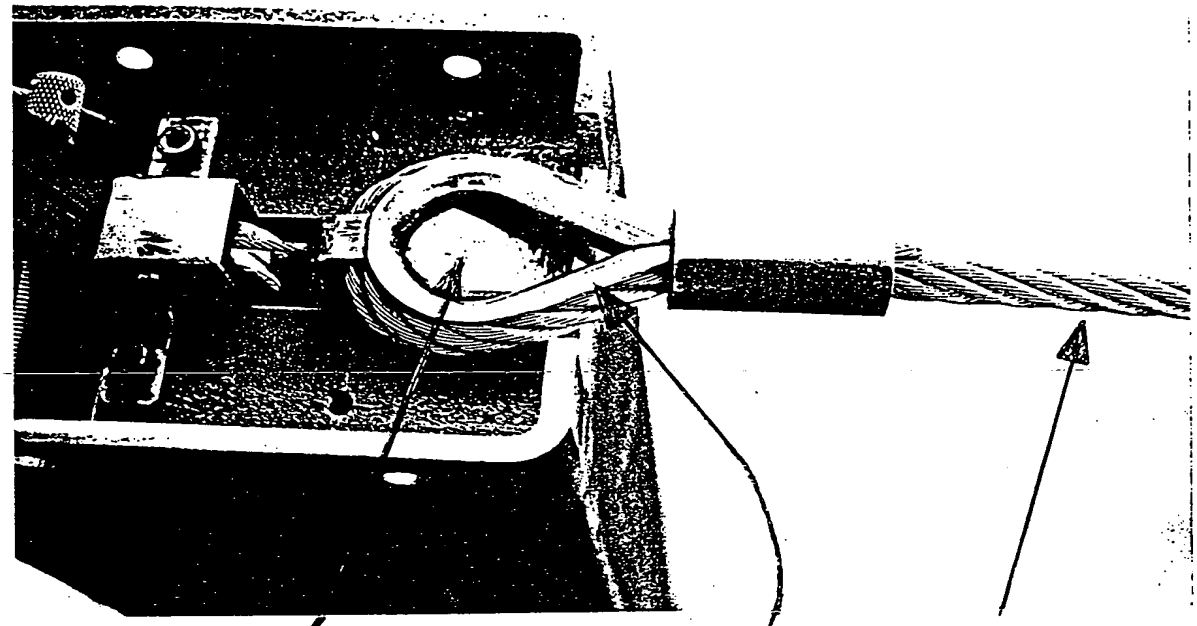


Fig. 2a – Basic Invention

Fig. 2b — Basic Invention



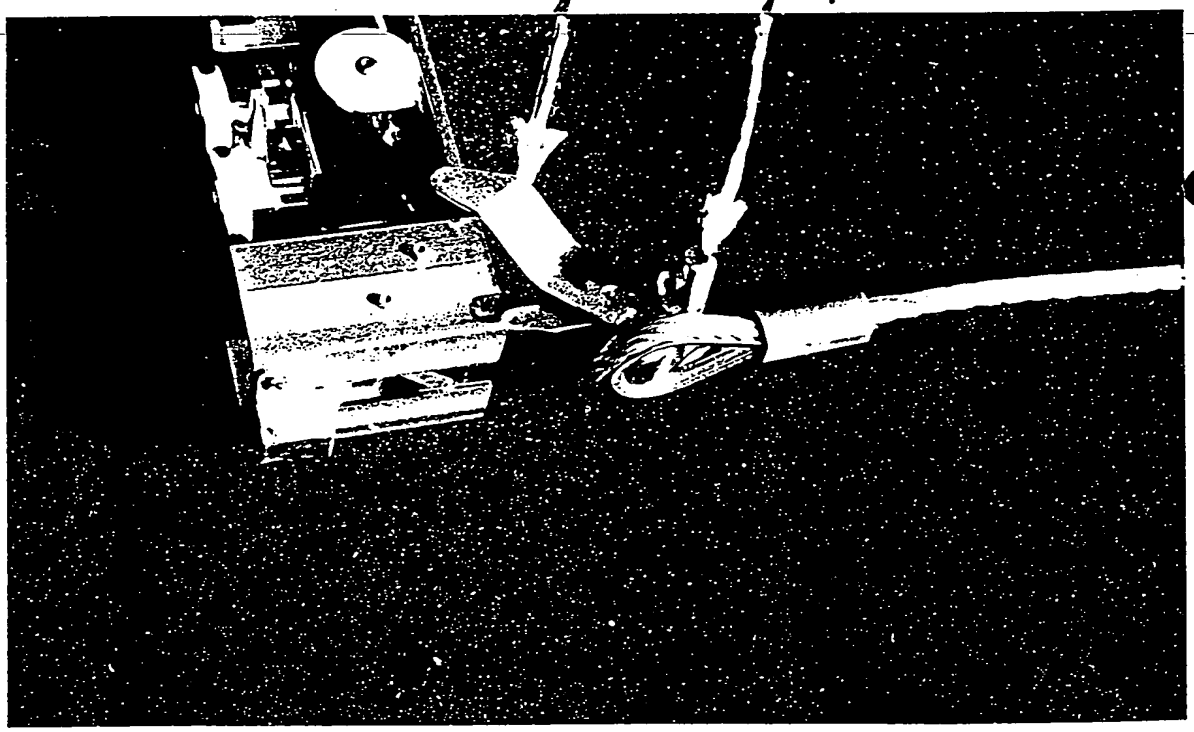
latch pin

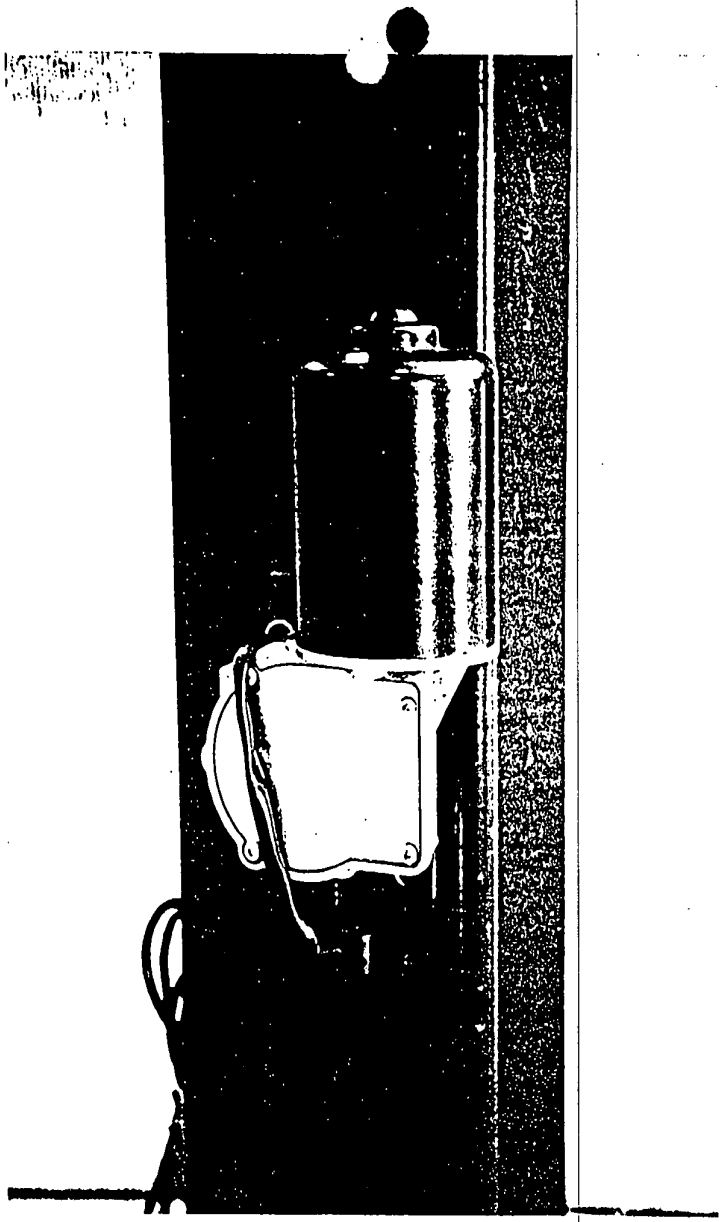
thimble

cable

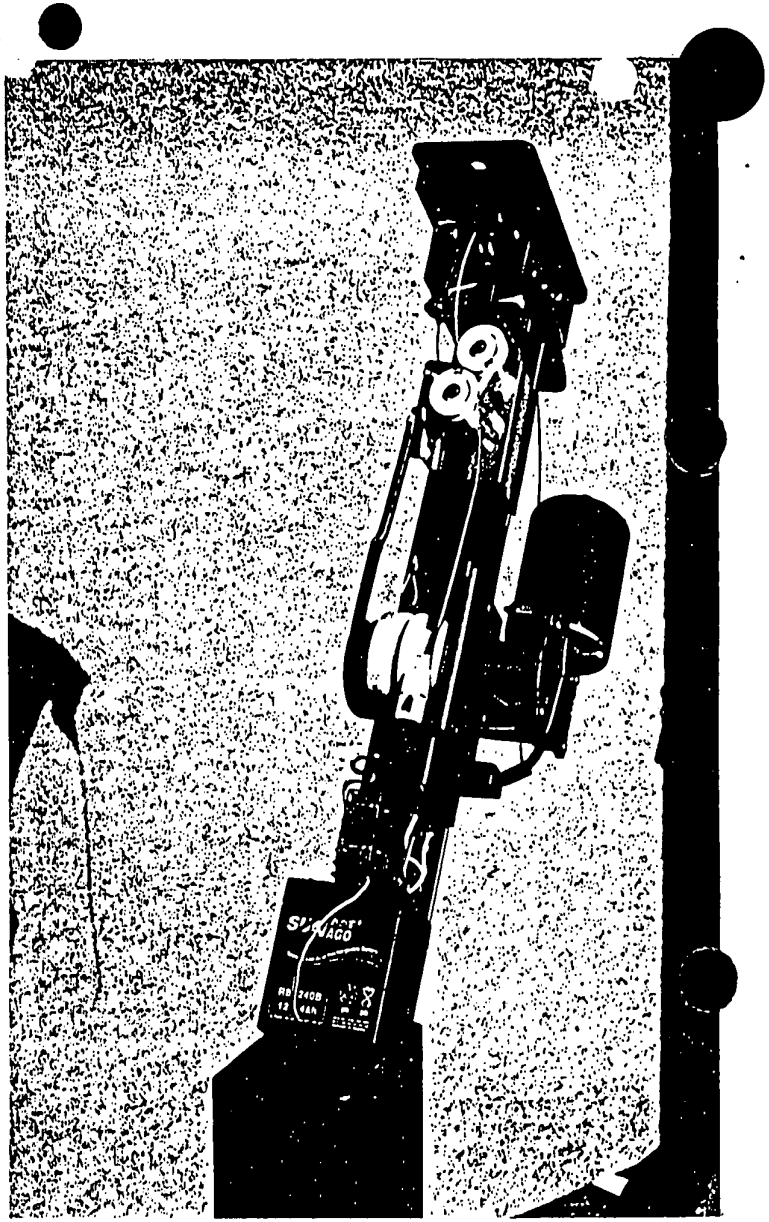
release lever

pivot





motor drive

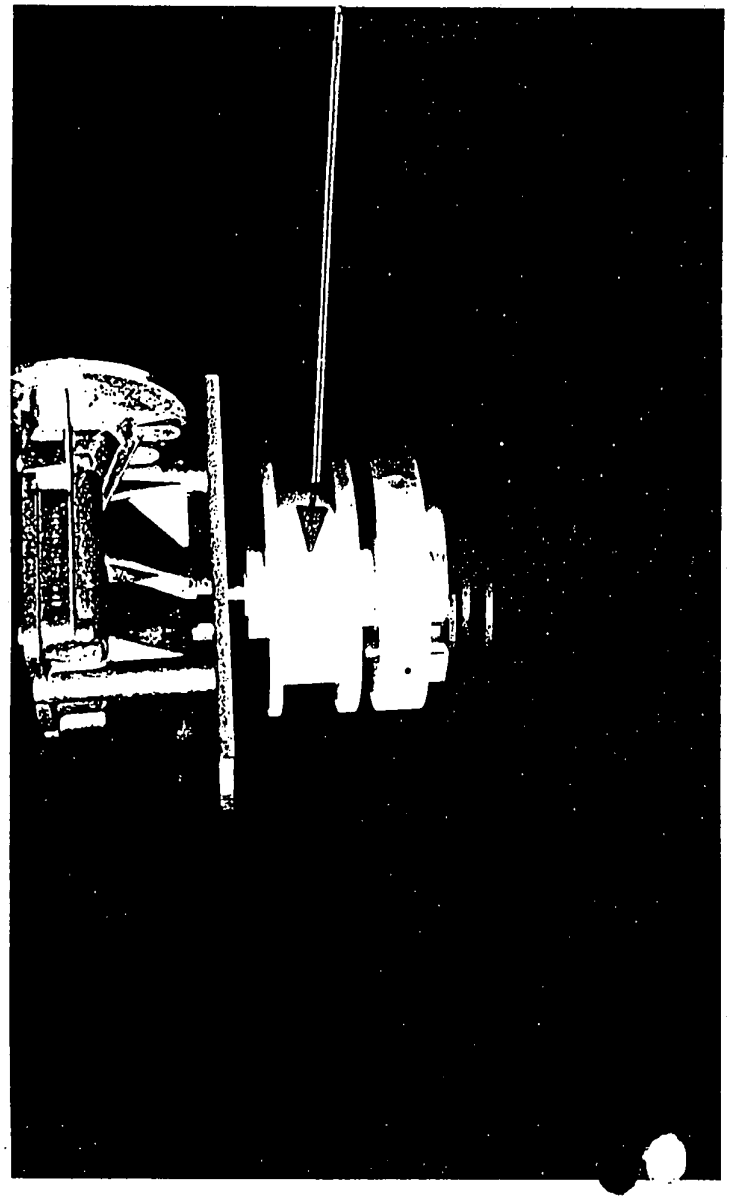


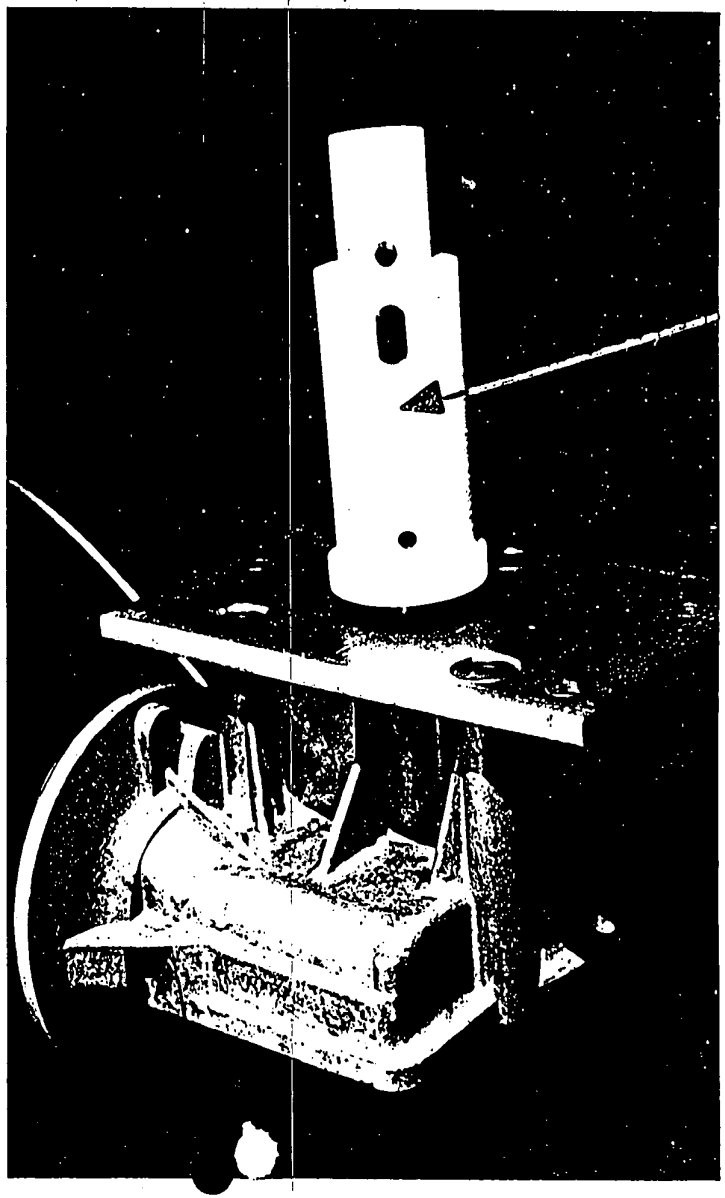
comple internal assembly

Fig. 3a – Drive Mechanism

Fig. 3b – Drive Mechanism

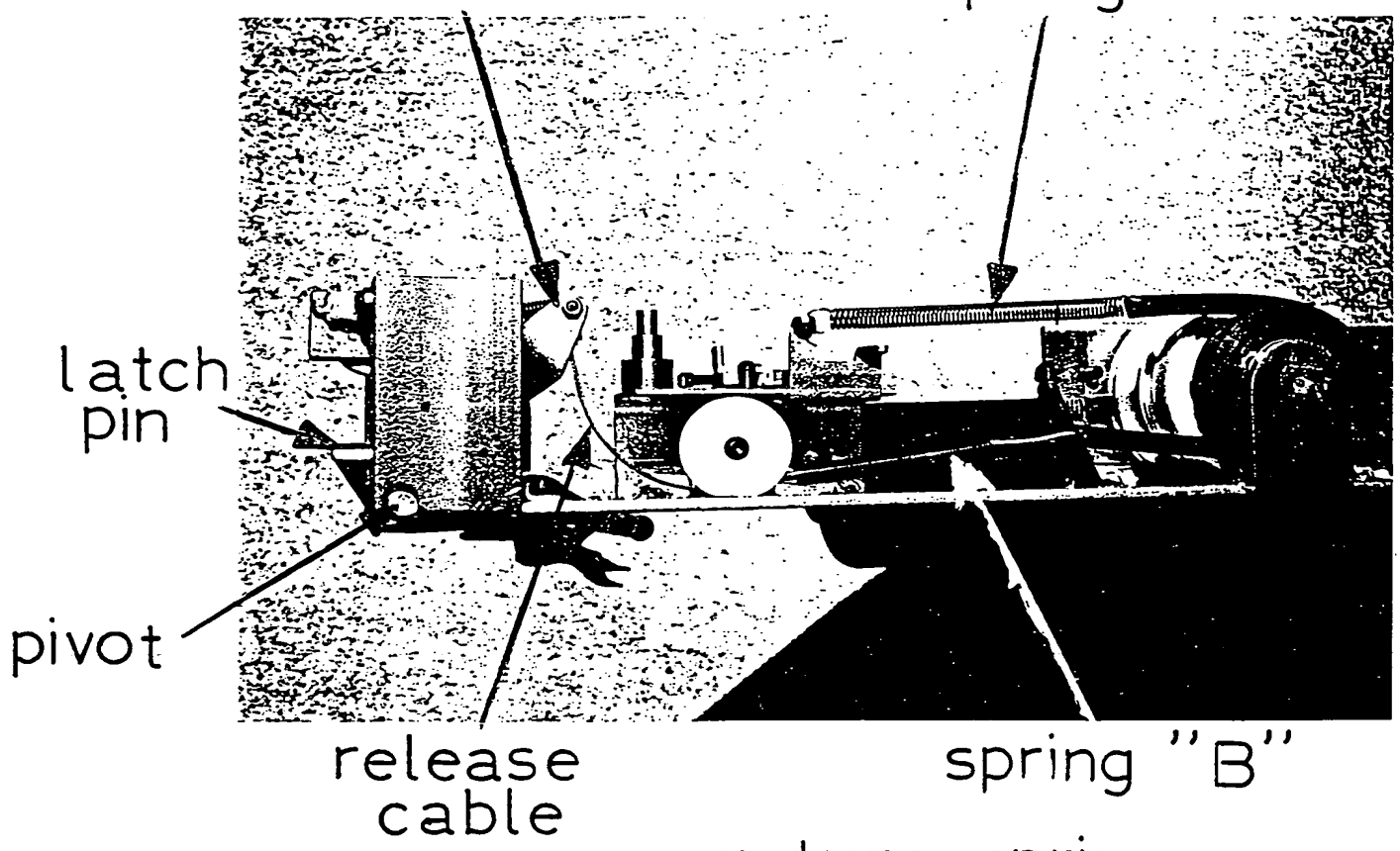
winch drum

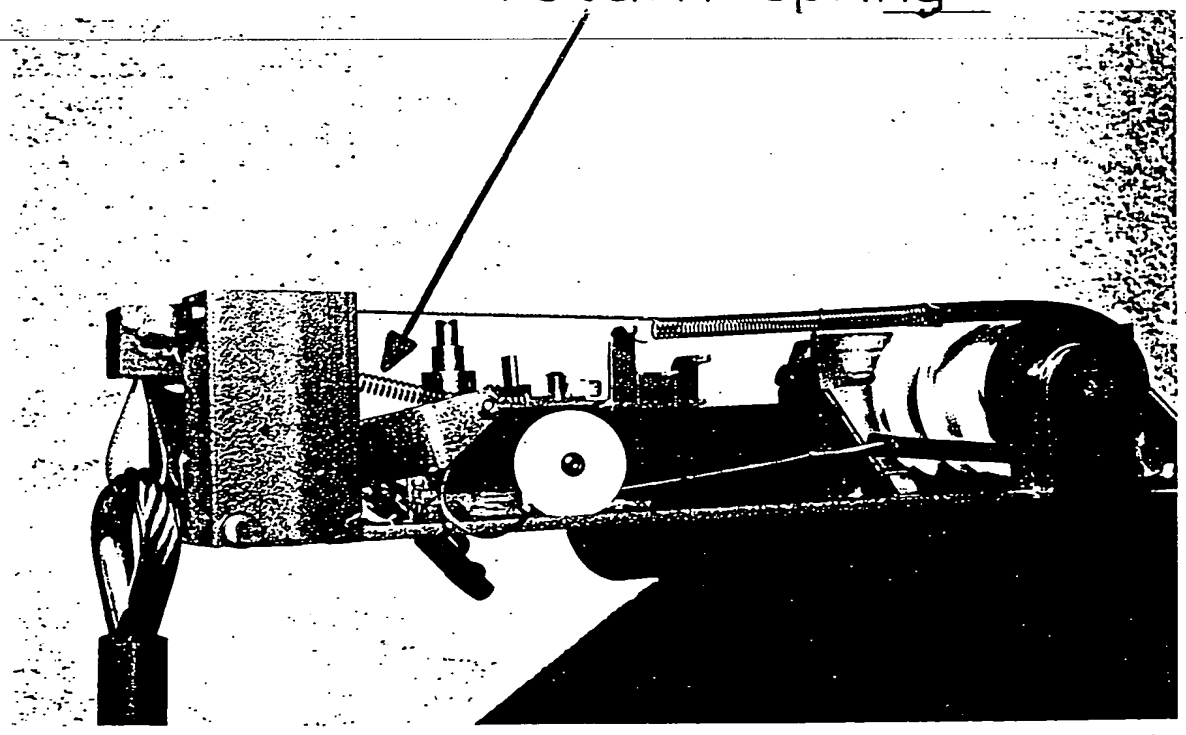




winch (drive) shaft

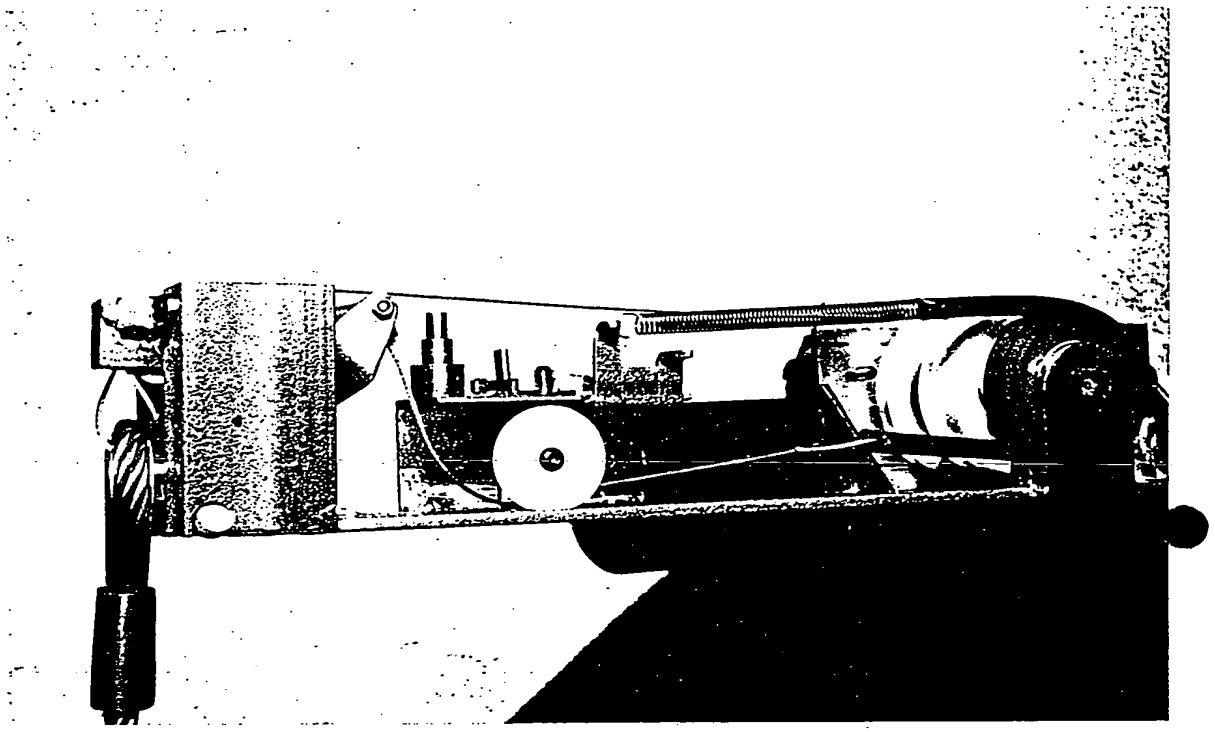
Fig. 4a - Latch Release



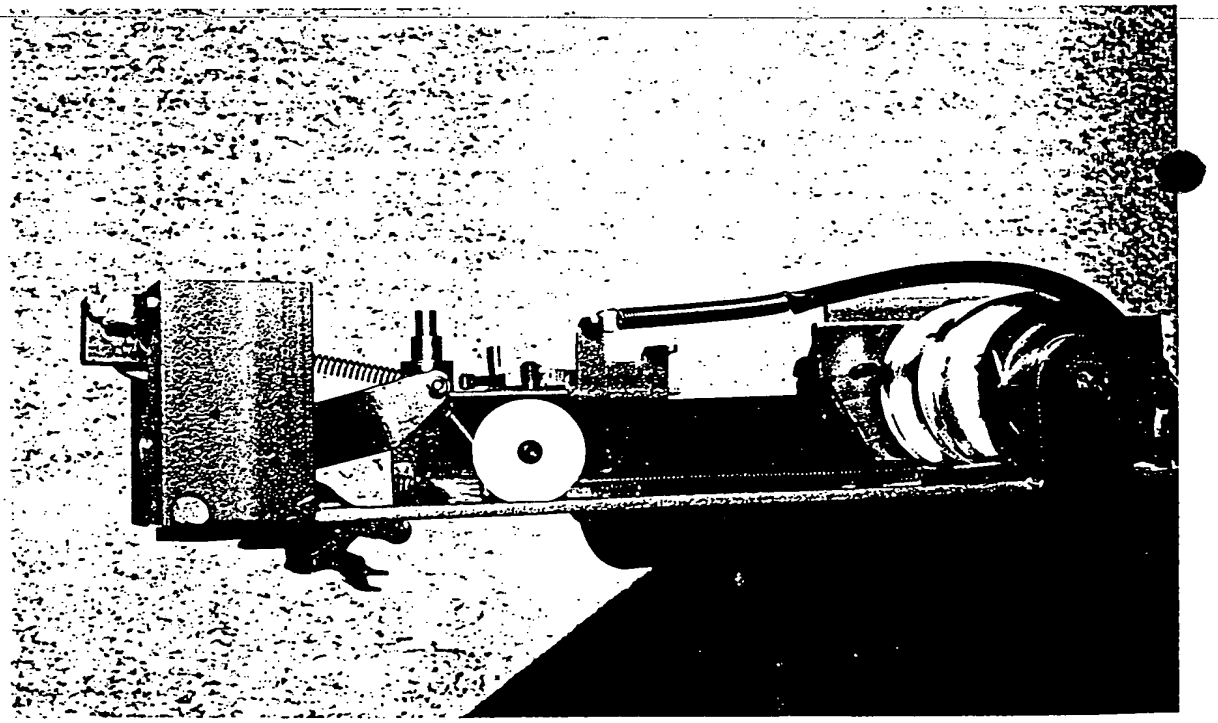


locking process - thimble enterin
latch forced open

Fig. 4b - Latch Release

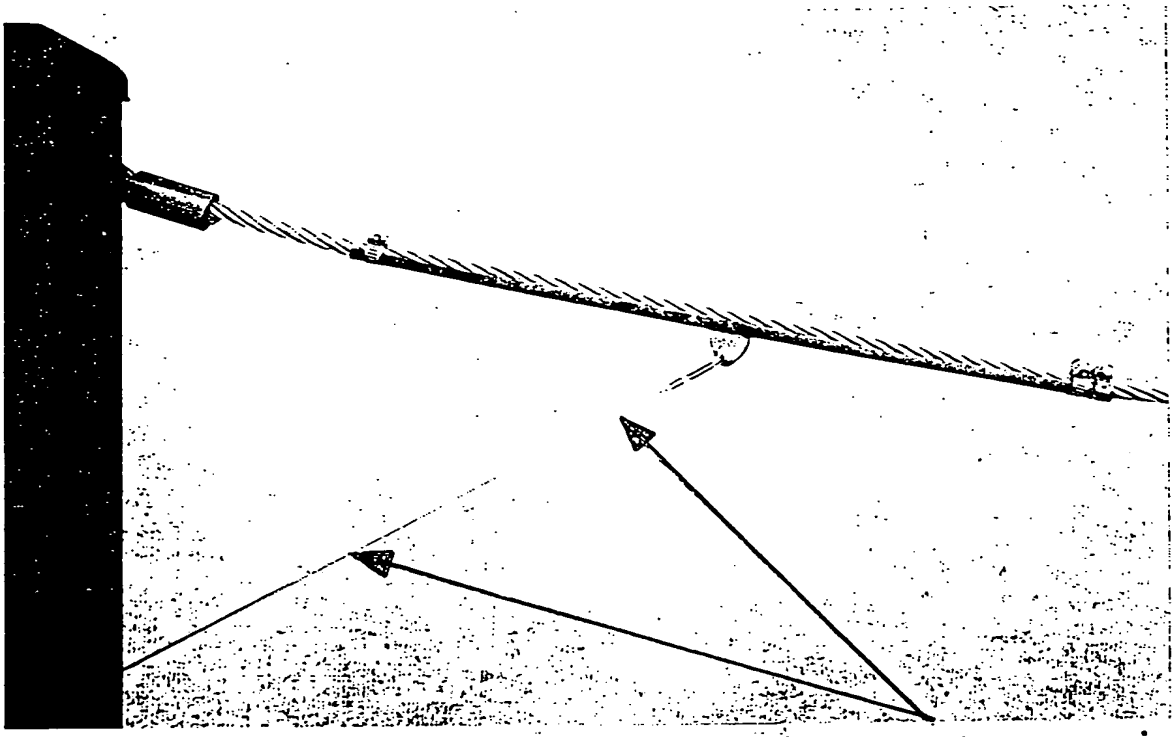


cable & latch in place - gate locked

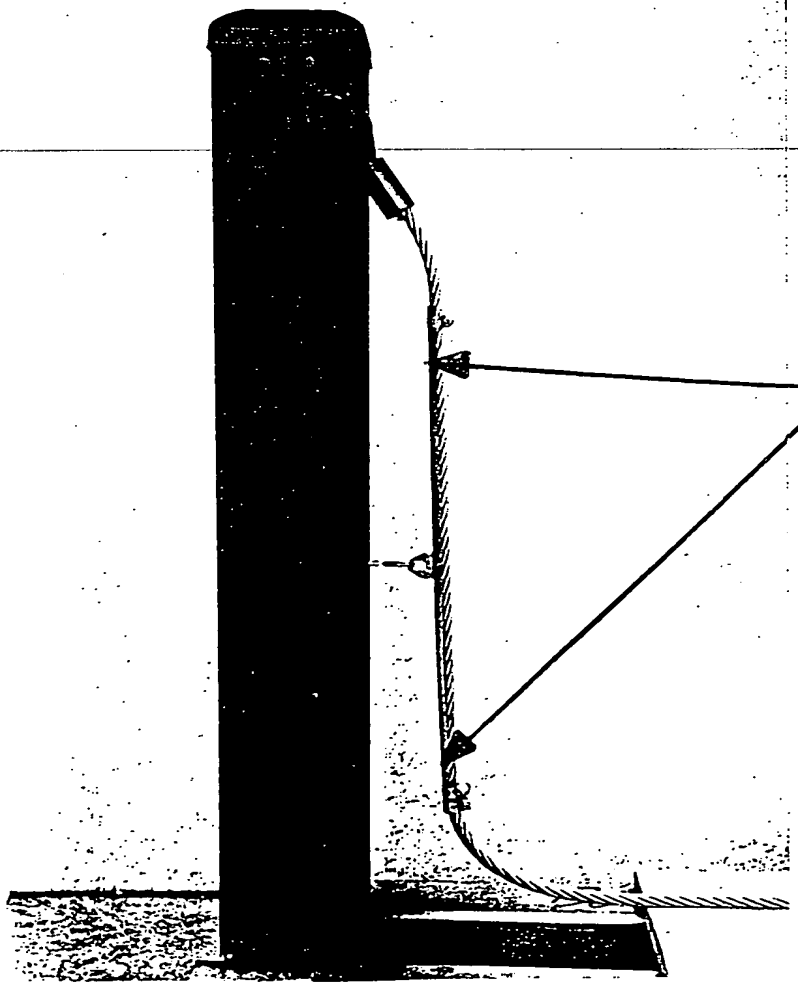


drive reversed - latch forced open

Fig. 5 - Passive Post



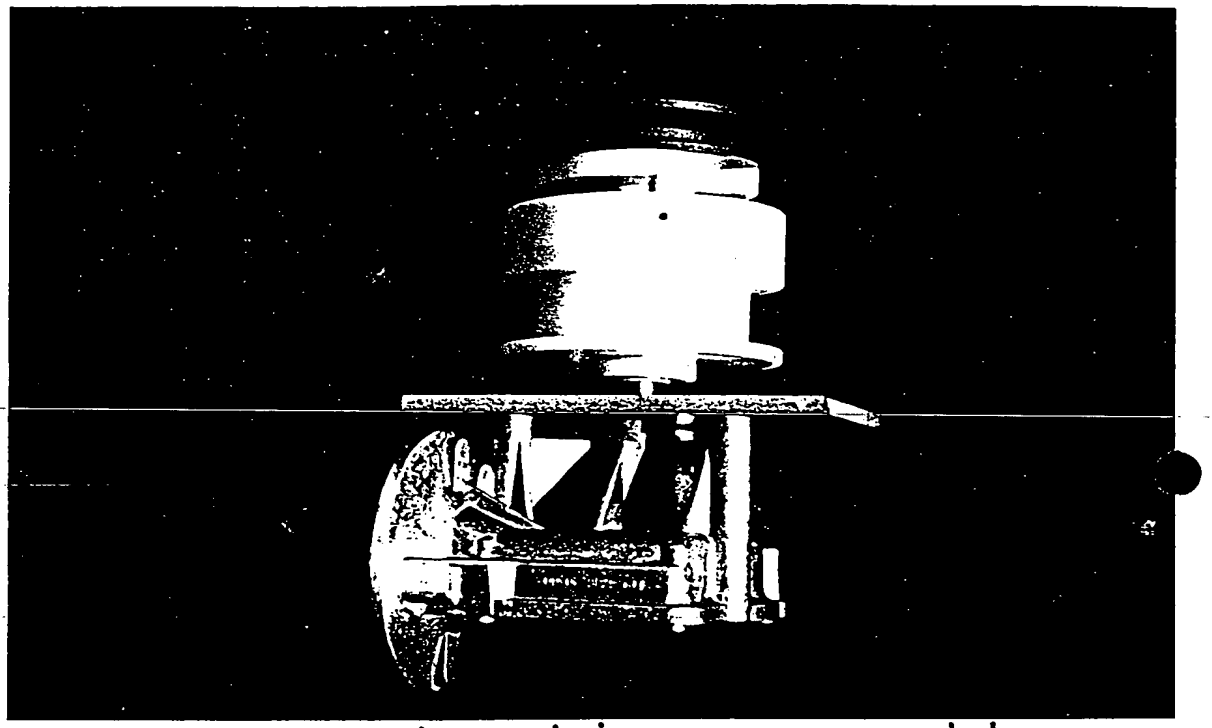
counterweigh
cable



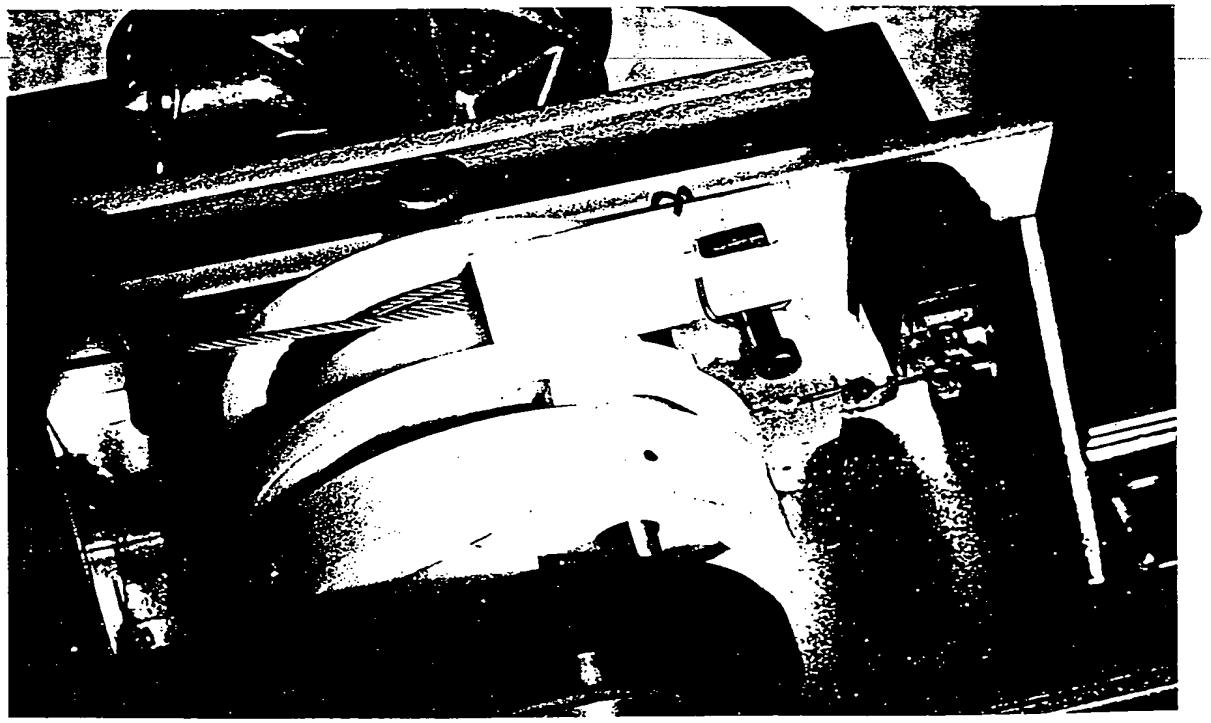
spreader
bar

gate oper

Fig. 6a – Quick Release



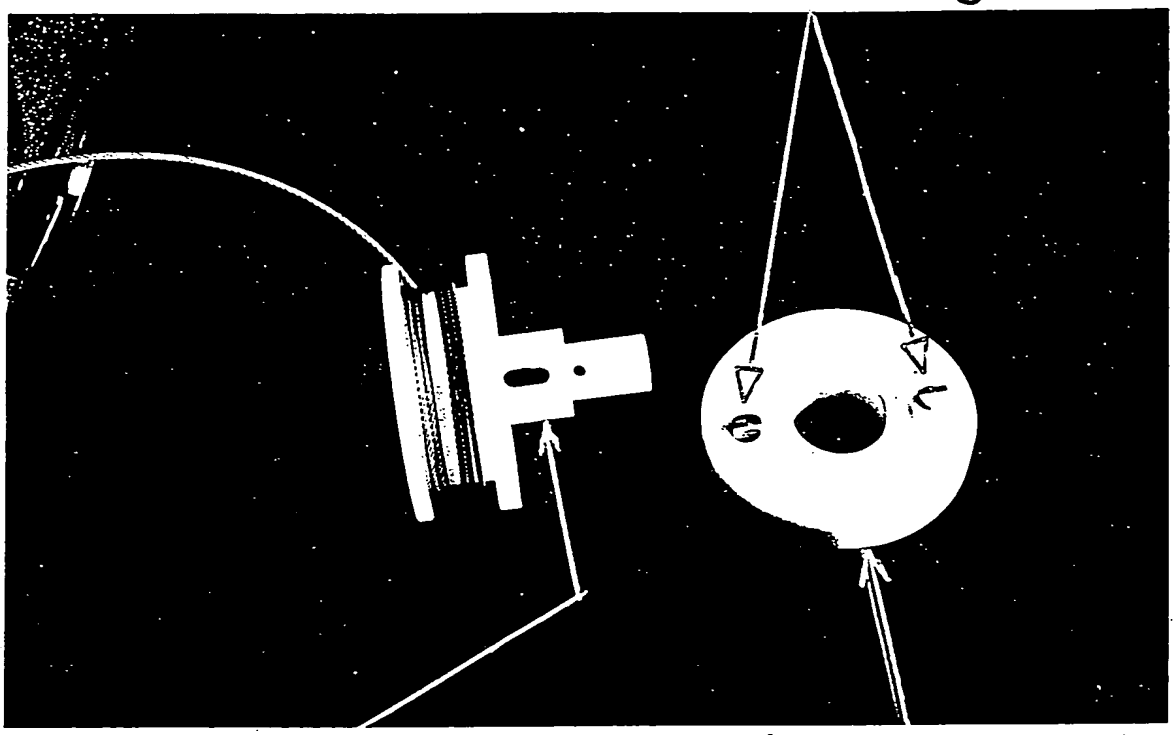
comple drive assembly



quick release arrangement

Fig.6b - Quick Release

clutch dogs

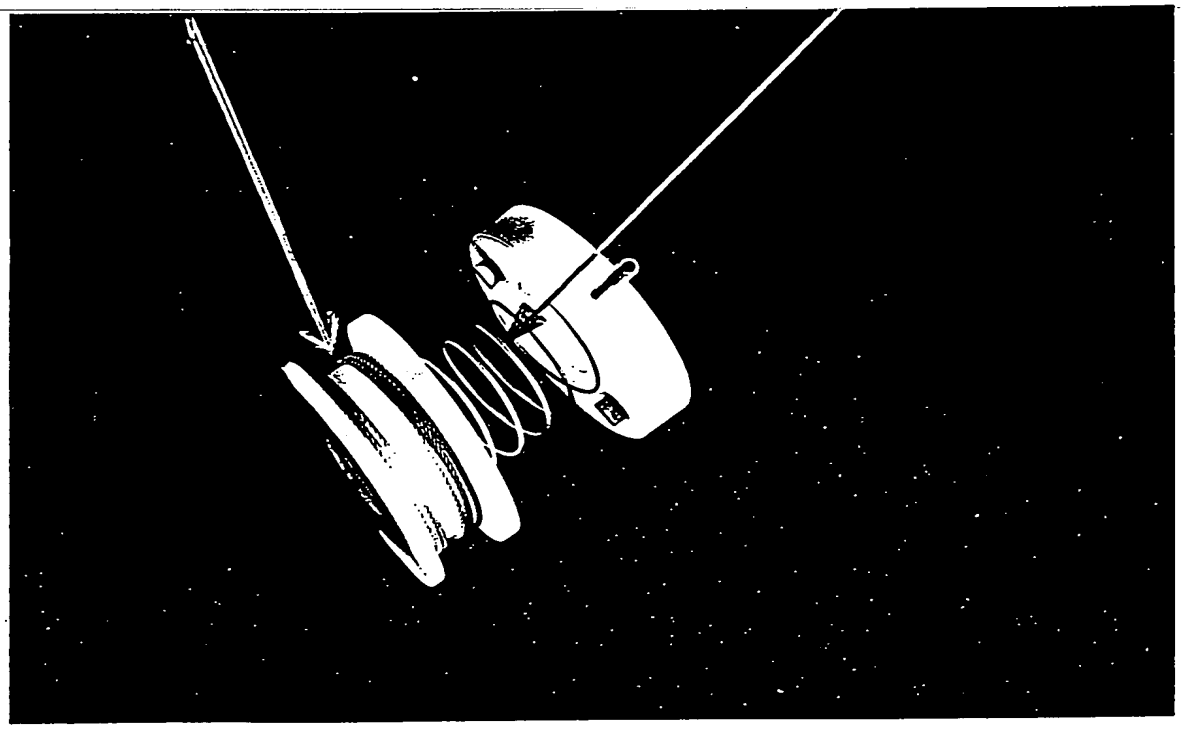


drive shaft

drive collar

winch drum

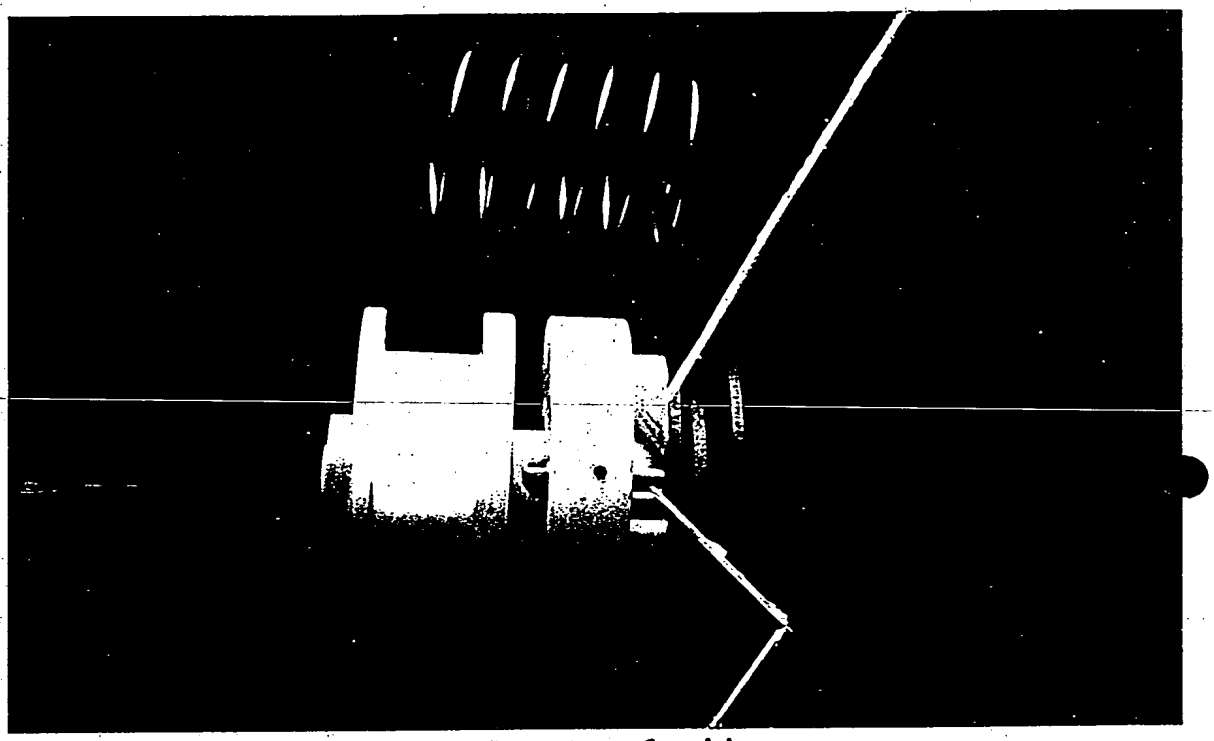
release spring



clutch system

Fig. 6c - Quick Release

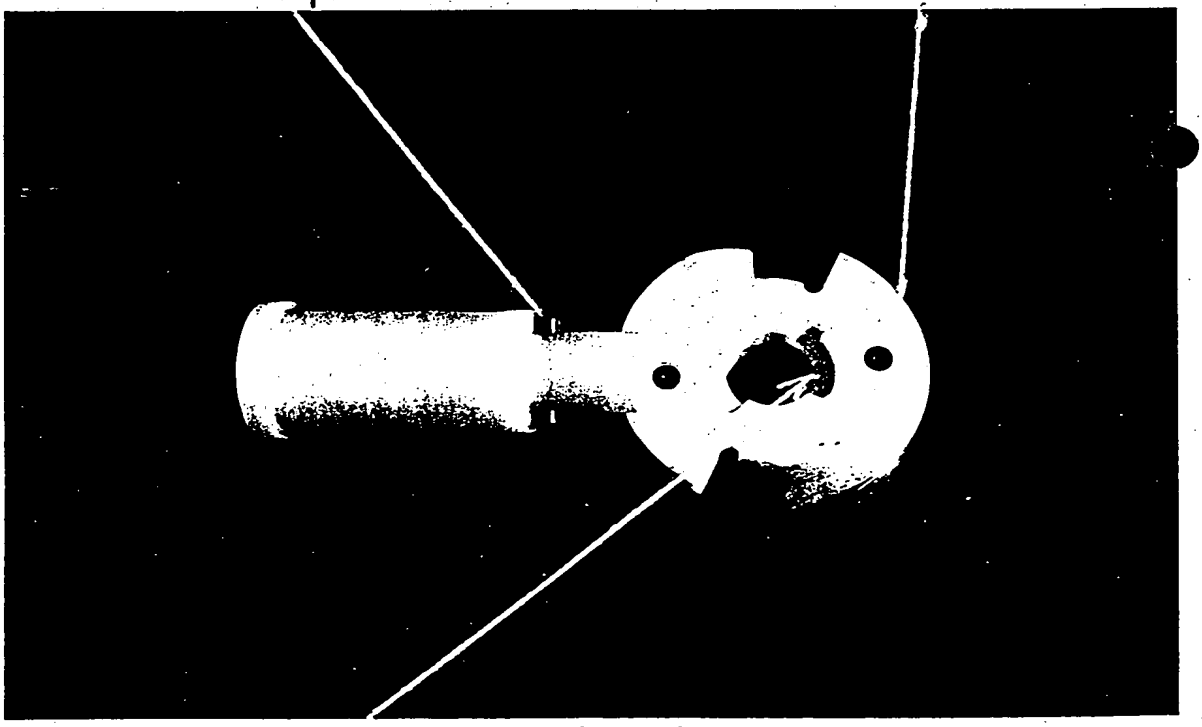
face cam



cam follower

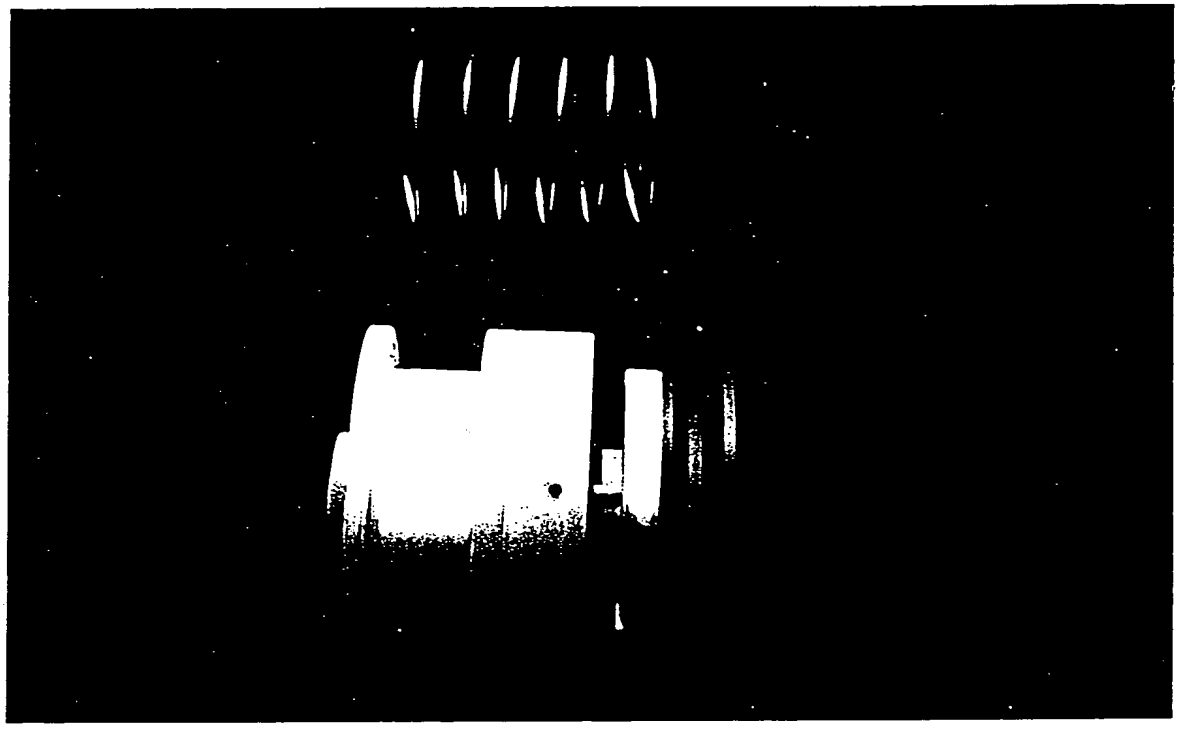
drive pin

cam hub

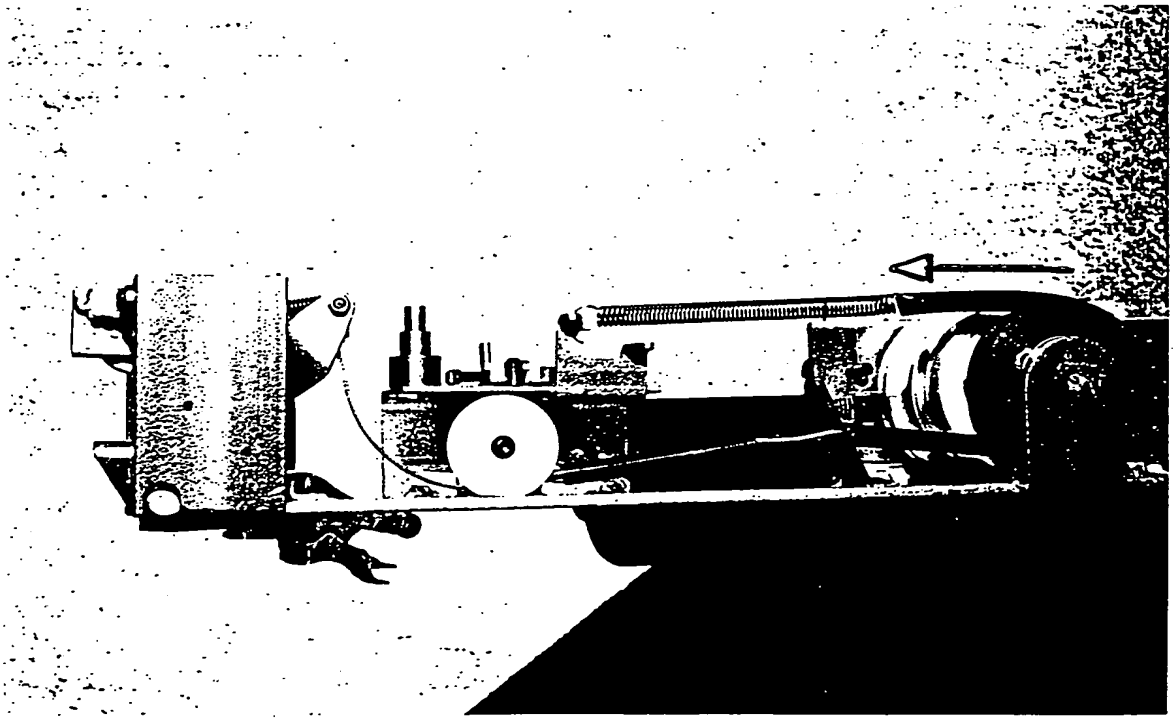


segmented slot

Fig. 6d - Quick Release

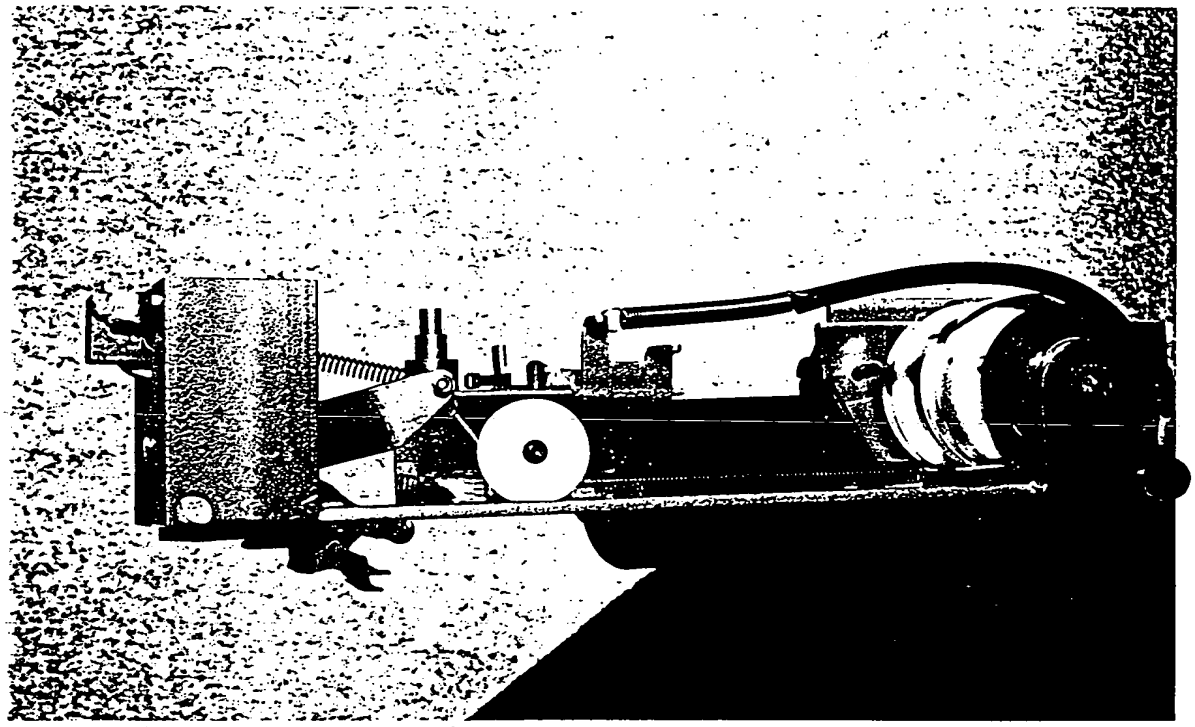


clutch engaged



retarding force engages clutch

Fig. 6e - Quick Release



opposite rotation releases clutch allowing rapid opening

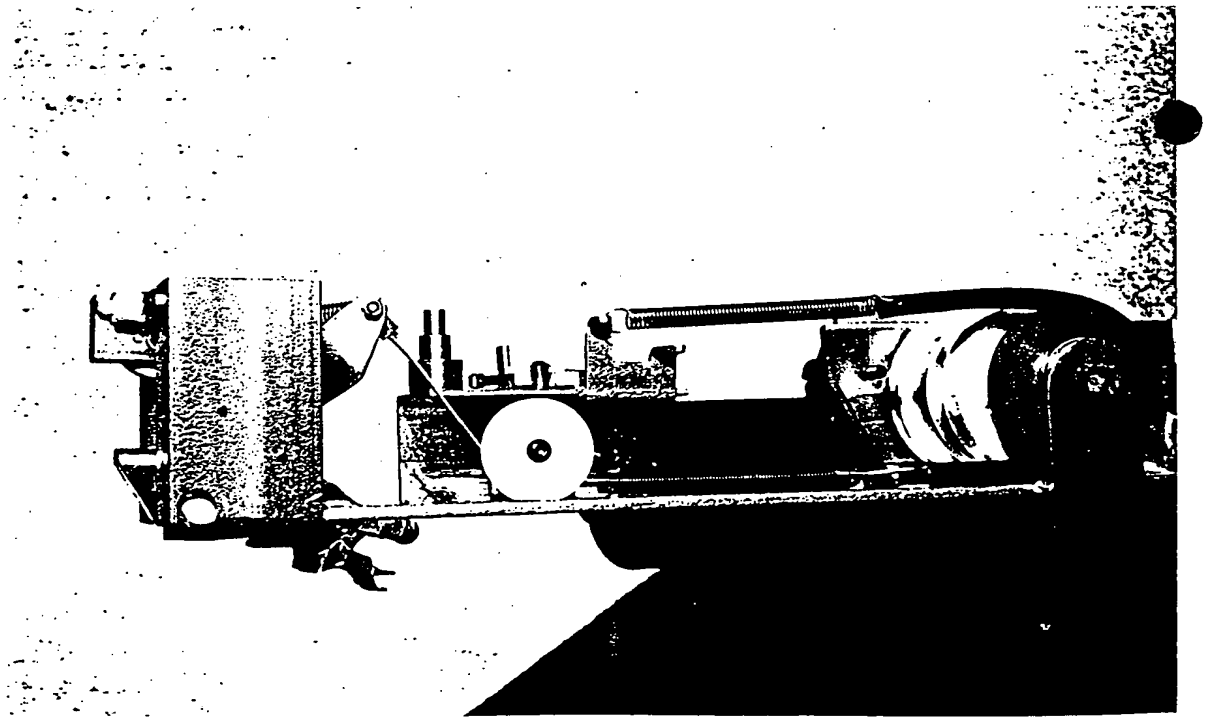


Fig. 7 - Winch Brake Unit

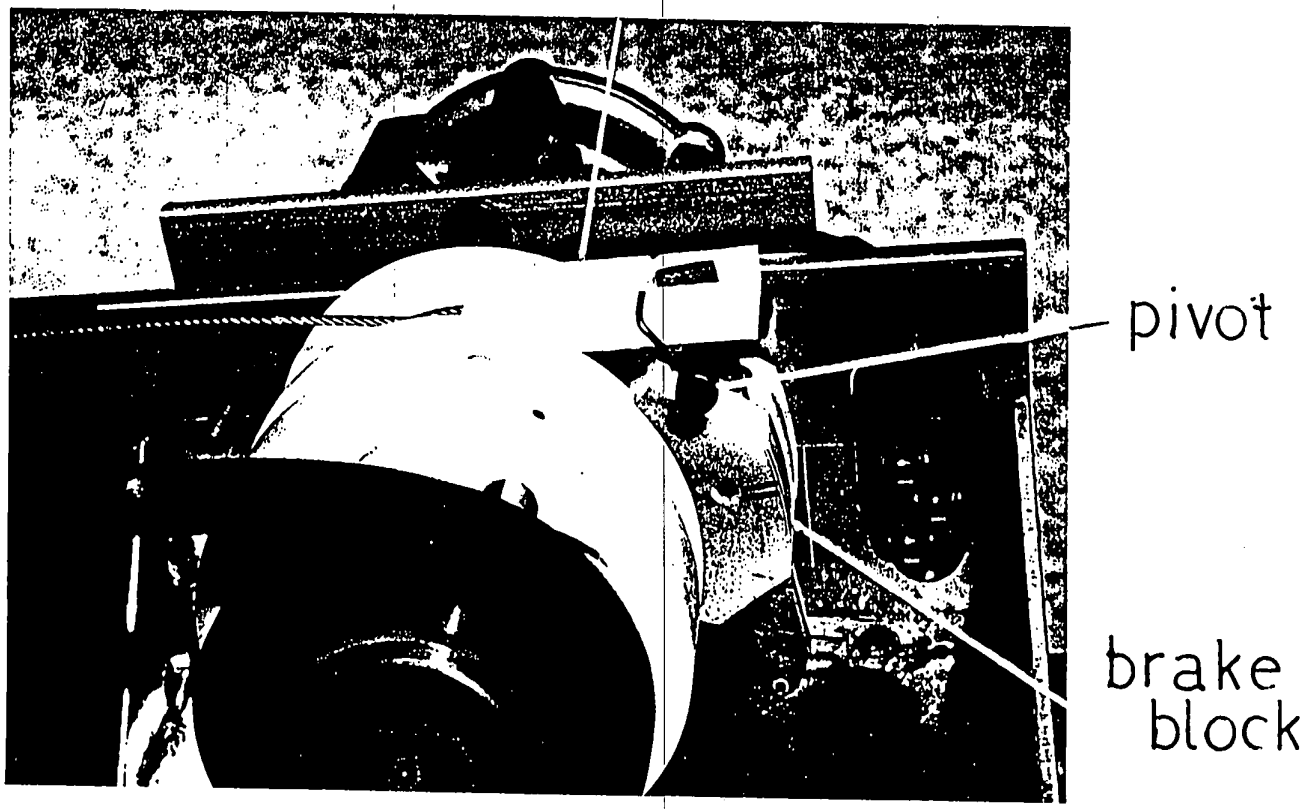
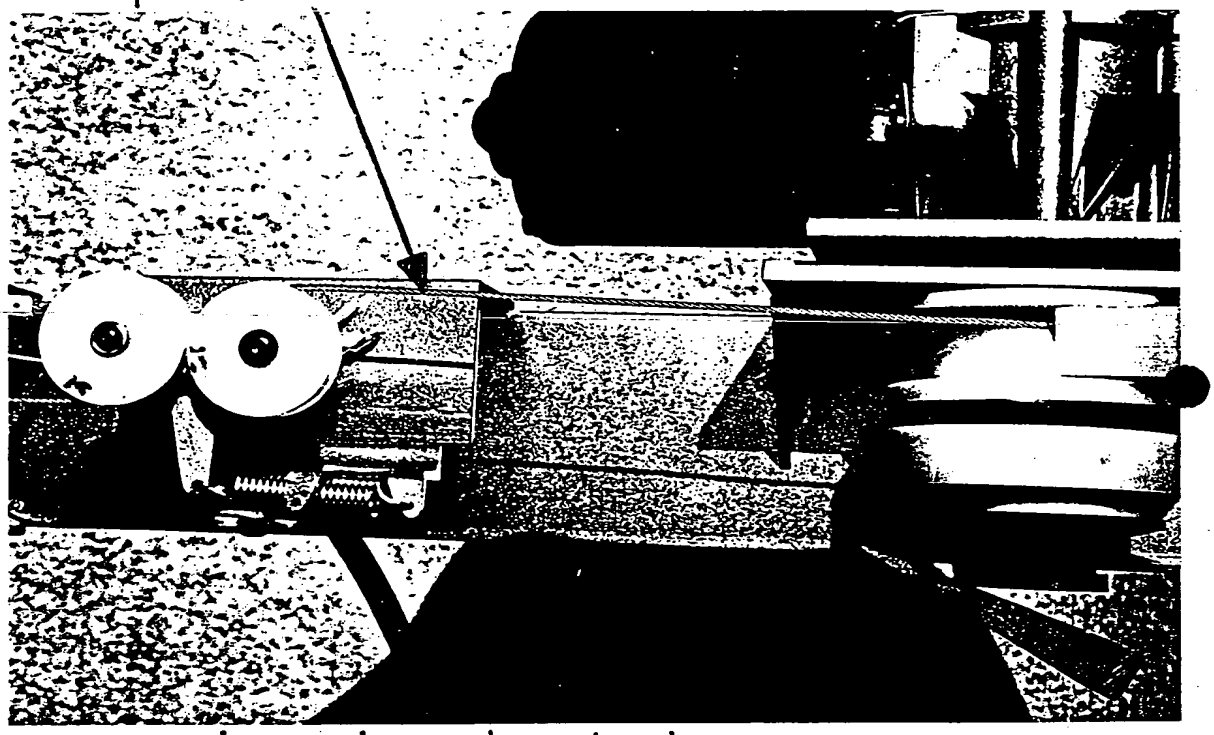


Fig. 8 – Cable Tracking Device



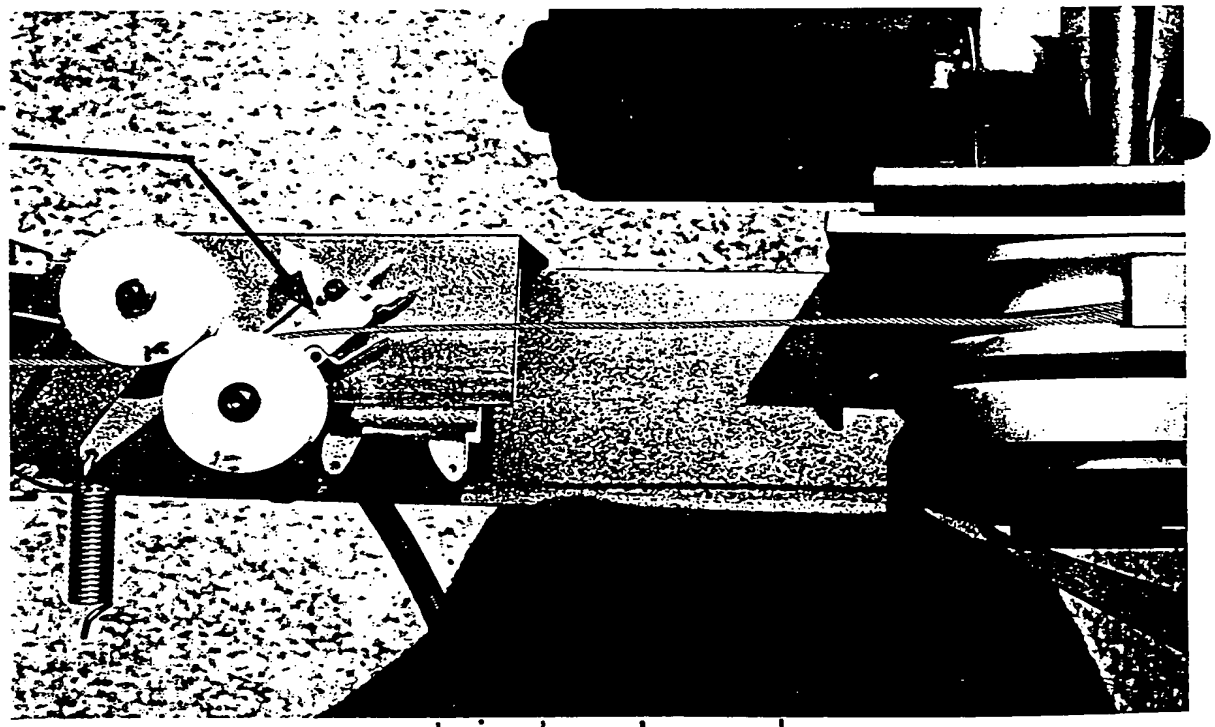
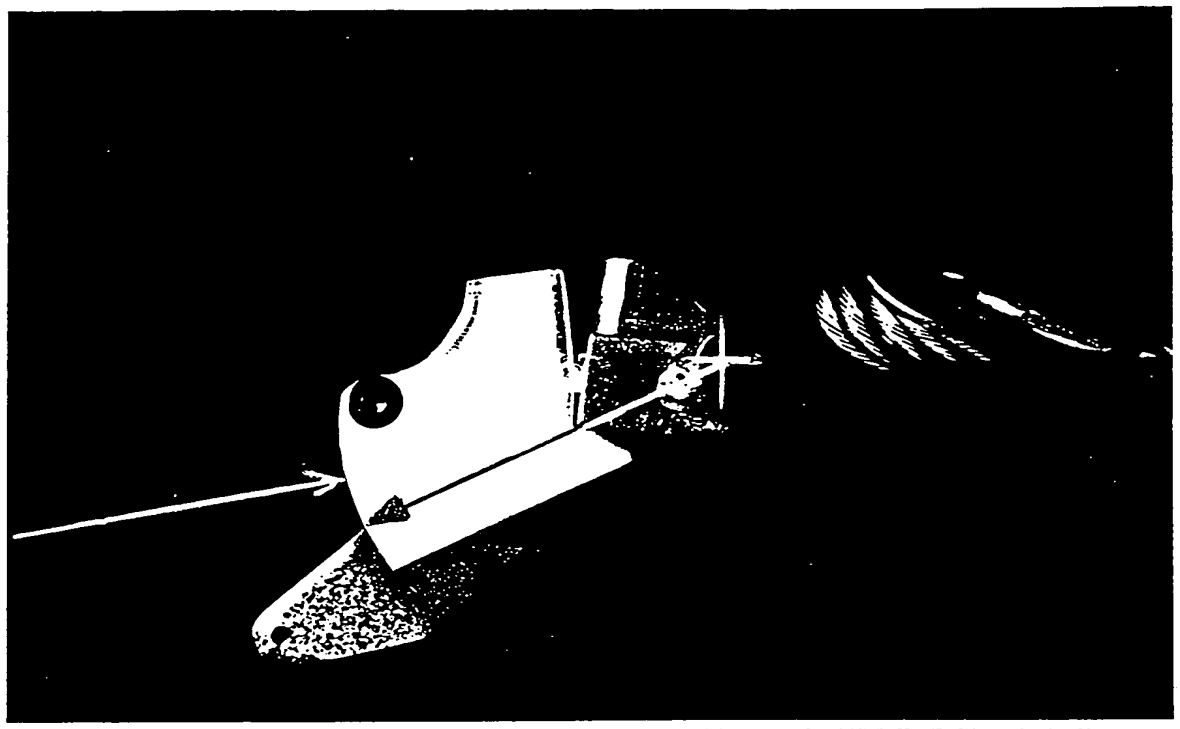
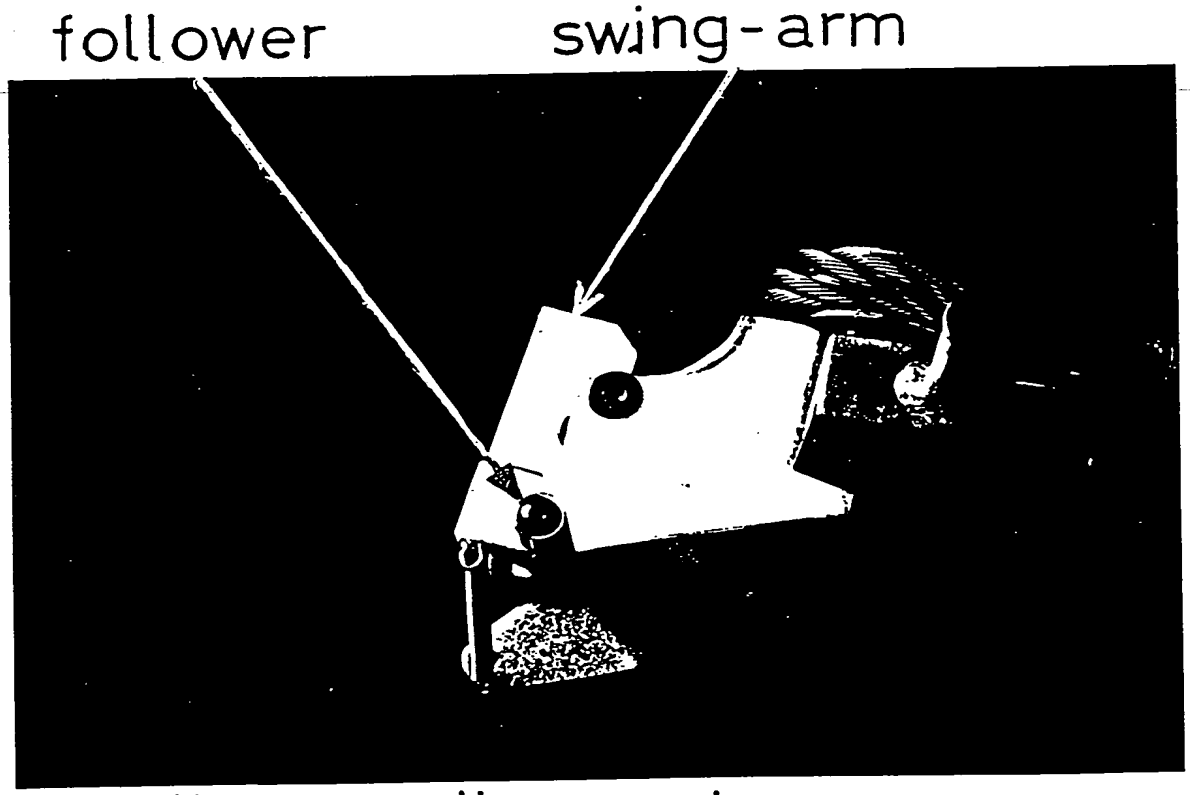


Fig. 9 - "Locked" Detection





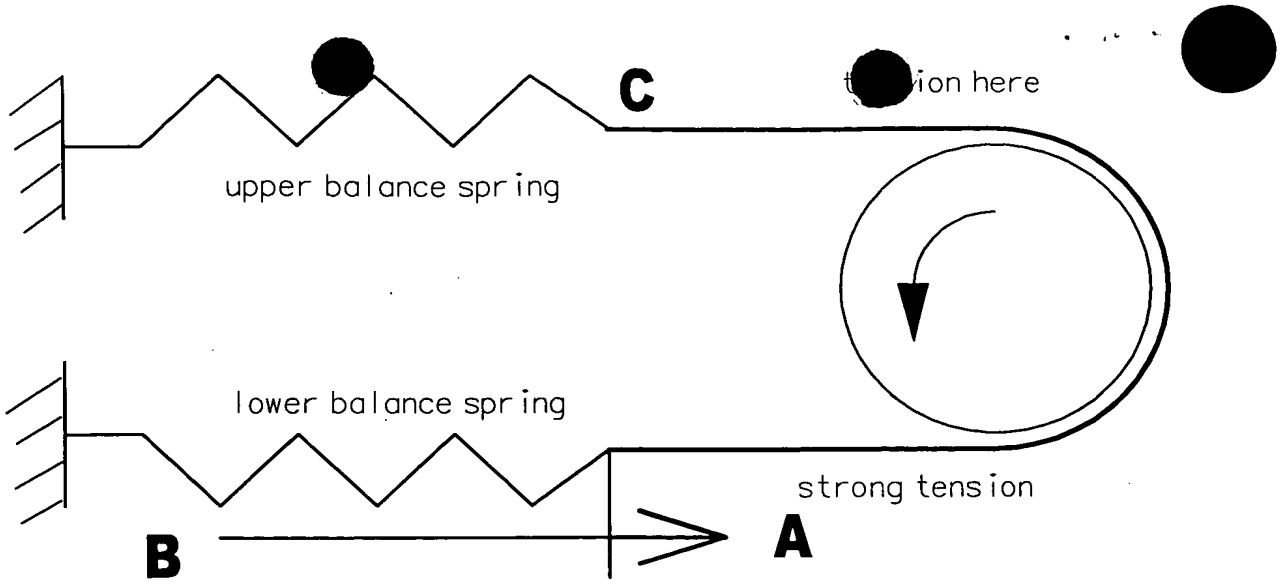


Figure 10A - UNLOCKING Action

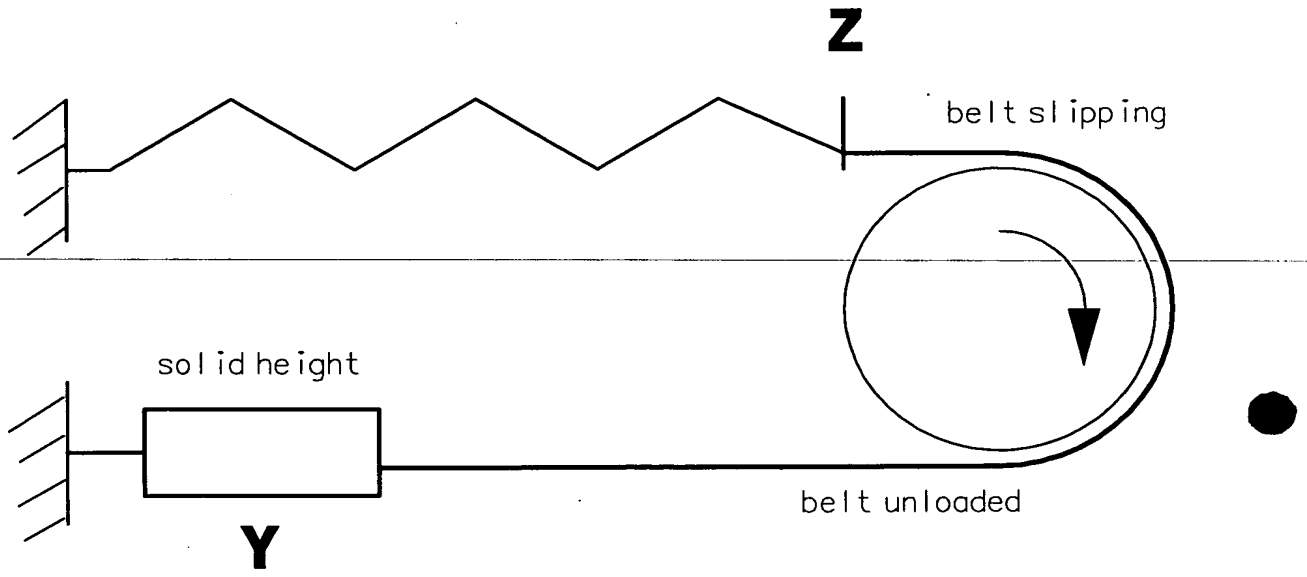


Figure 10B - LOCKING Action

FIGURE 10 - CAPSTAN DRIVE MECHANISM

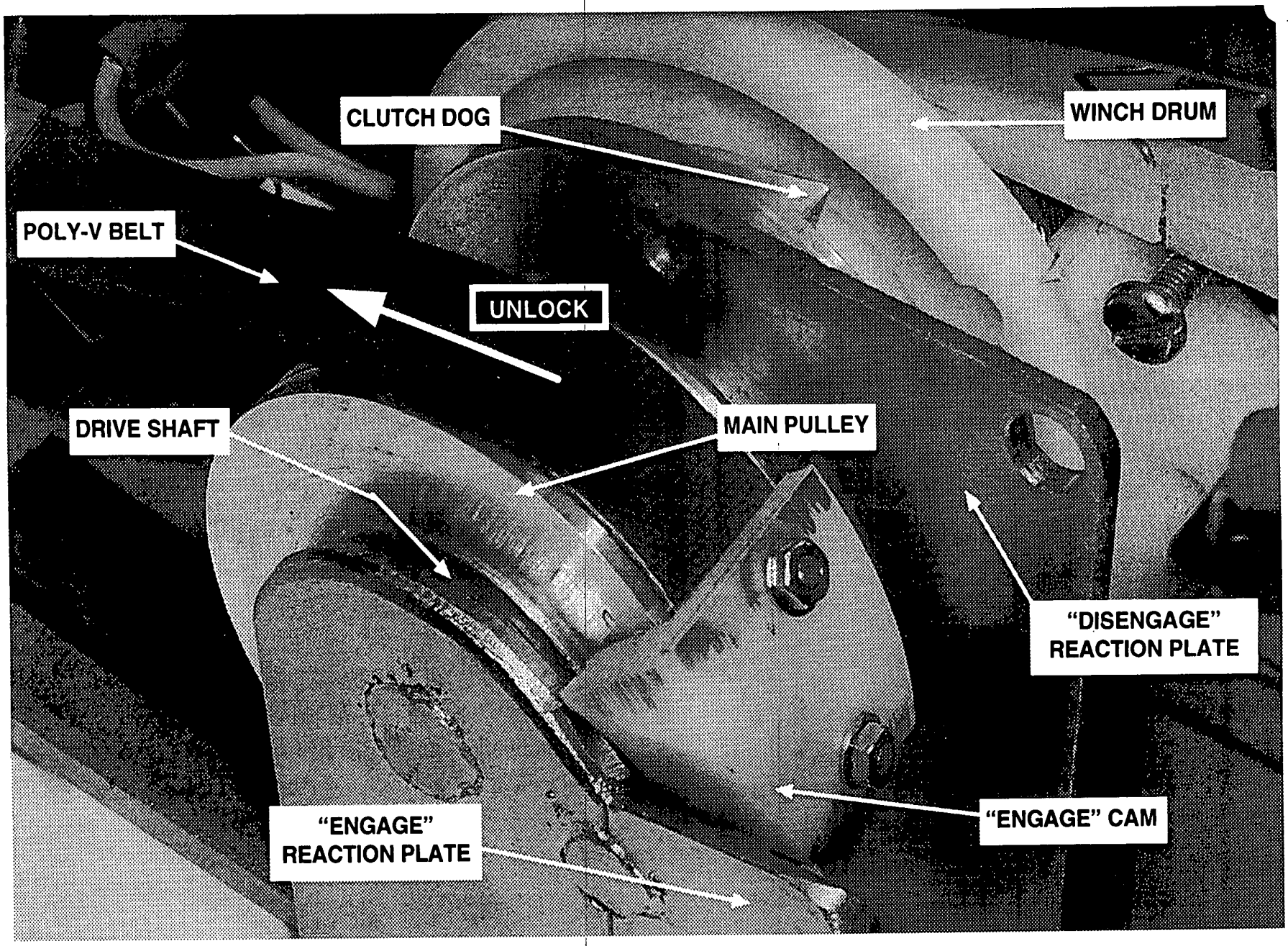


Figure 11 - Clutch Disengaged

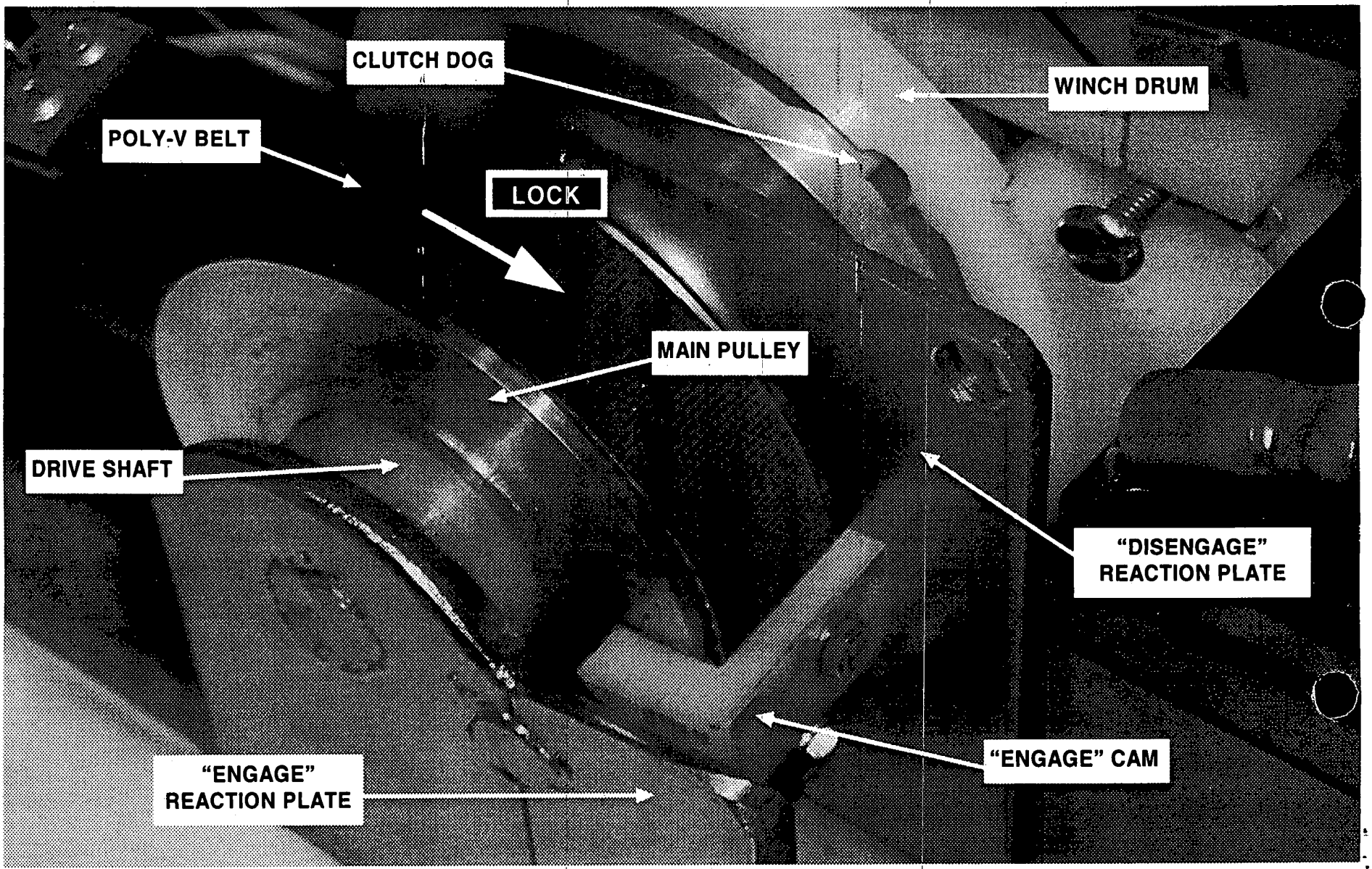


Figure 12 - Clutch Engaged

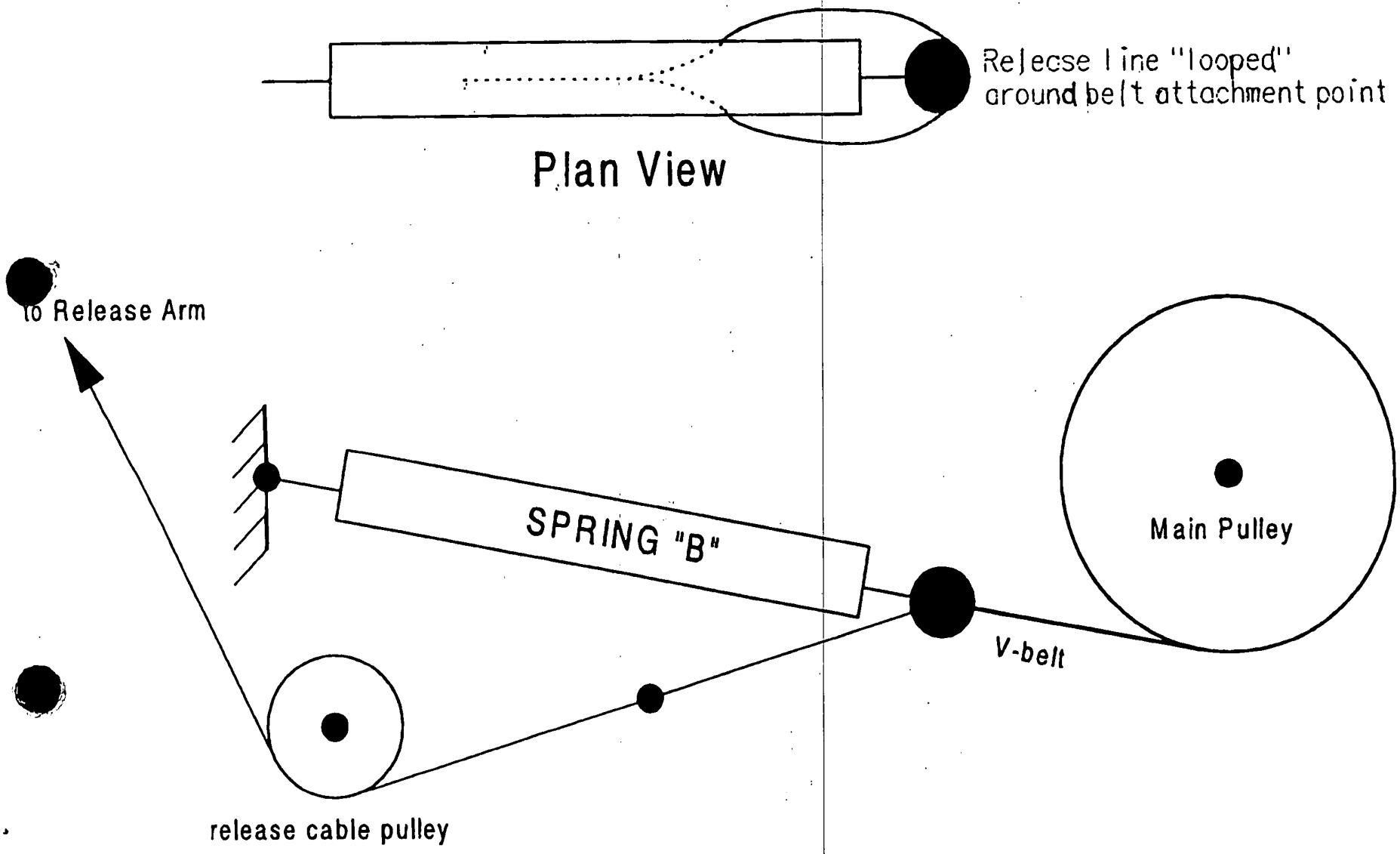


Figure 13 - Release Cable Arrangement